Galileo's Undone Gravity Experiment : Part 3 — Gravitational Wave Doubts and Epilogue for all Three Parts

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Abstract. —
We carry over from **Part 2** the theoretical physics perspective of hypothetical alien Rotonians. Having come to Planet Earth from a rotating cylindrical world where conceptions of physics all stem from a firm belief in the truthfulness of accelerometer readings and where the concept of gravitational attraction is unknown, Rotonians' most urgent purpose is to perform Galileo's Small Low-Energy Non-Collider experiment. Doing so would unequivocally either support or falsify their approach, which clashes so dramatically with Earthian (accelerometer-schizoid) physics. Although most of our critique on the LIGO industry is independent of any new model, the novel Rotonian perspective adds cogency. See §16.2. Earthian gravitational physics has recently culminated in the huge hardware and personnel investment, purporting to have yielded measurements of dozens of gravitational waves (G-Waves). For many compelling reasons, Rotonians have never accepted the premises of this sprawling billion-dollar enterprise. Their suspicions are certainly not reduced by the fact that the G-Wave community's monumental machines were *designed* to be able to give the impression that injected fake signals are the real thing. Evidence abounds that *none* of the LIGO/Virgo reports of G-Wave detections are what they claim to be.

PACS 04.80.Cc – Experimental tests of gravitational theories.

1. Introduction: Gravitational Waves or Giant Hand-Waving Mistake ?

> *[If **everything** is stretching] . . . how do you know **anything** is stretching? That's the conundrum. It doesn't make any sense! This whole thing is bogus! Shut it down!*
>
> Rana Adhikari : (LIGO Physicist) : [Tongue-in-cheek self-criticism] 2017 Interview [1]

> *Given the numbers involved in the strength of gravitational waves in their interaction with detectors . . . one of my main goals . . . is to cause you to question deep in your soul whether it could be possible for us to detect them or not. I would like to question whether we have left out something crucial. And the name I give to that questioning is the Rubber Ruler Puzzle. [Given these numbers and the unsettling implications of this puzzle, it would be understandable for you to have] spent at least one half hour of your life convinced that this whole thing must be a giant mistake.*
>
> Peter Saulson : (LIGO Physicist) : [Partially paraphrased reflections] 2018 Lecture [2]

1˙1. *Historical Context*

General Relativity (GR) — Einstein's theory that famously accommodates the prediction that gravitational waves (G-Waves) exist — was born in 1915. Joe Weber announced the first detection of G-Waves in 1969. On GR's centennial, 46 years later, the LIGO Collaboration once again achieved the first detection of G-Waves. [3] Within a few years following Weber's measurement, his data were almost unanimously judged to be spurious. [4] LIGO's measurement — made a few months before their February 2016 announcement — is widely regarded as humanity's first *bona fide* detection of G-Waves. The story of how G-Waves came to be predicted, unpredicted, mired in uncertainty, and predicted again by practitioners of GR is well told in Daniel Kennefick's book, *Traveling at the Speed of Thought*. [5]

As described in detail in **Part 2**, briefly in our opening **Abstract**, and again with some detail in §16.2, the hypothetical tech-savvy civilization of alien Rotonians are suspicious of the whole billion-dollar enterprise. Compelling reasons why *everyone* should be suspicious are plain enough to see — at least they will become plain after we uncover and consolidate the facts of a complicated history and ongoing marketing extravaganza. Some readers may be thinking: "Everybody knows" G-Waves have been found and measured many times since 2015, so it is foolish to be suspicious of such "well-established" science.

Readers of **Part 2** will recall how very much of "established" physics and cosmology is on shaky ground. From its own practitioners, words like "crazy," "preposterous," "ridiculous," "ugly," "bizarre," "mess," etc. are used to characterize some of its most cherished, tightly clutched investments and underpinnings. Things do not get any prettier in the field of G-Wave research.

The status of G-Waves is arguably exceptional because of the allegedly direct empirical evidence adduced by the LIGO/Virgo Collaboration, which purports with abundant and impressive detail to establish the observation of G-Waves. To propose that these measurements are not what they are claimed to be is tantamount to calling out a fraud and a hoax and a self-and-other delusion and deception of unprecedented proportions.

Rotonians are well aware of the stakes of the game and the preponderance of contrary appearances bearing down against them. Yet we persist because, when all the evidence is fairly judged, we assert that *a fraud and a hoax in the halls of LIGO is much more likely than the widespread, flashy claims that their data are actually measurements of G-Waves.* As though to anticipate the perpetuation a hoax, both the means and the motive, the opportunity, and even the needed *culture* have been baked into the LIGO enterprise for years. From the Rotonian perspective, the most important evidence is found in the inescapable *contradictions*, questionable assumptions, and examples of unphysical "reasoning" that plague the history of G-Waves as a whole and LIGO's current sales materials, in particular. Intolerable sloppiness and mudfoggery abound. Our purpose is to convince every reader that, as stated above, hoax is more likely than the fantastic yarn being sold to the tax-paying public.

1˙2. *Subjects of Discussion*

Supporting evidence begins with the arguments in **Part 2** pertaining to absurdities within GR: its predictions of singularities, its claims that the motion of test objects can be caused by "geometry" or by *static* bodies of matter, and that accelerometers are schizoid liars. Such arguments provide at least *seeds* of doubt. If the "ugly" prediction of the existence of "all hell broke loose" black holes is based on flimsy, misguided theoretical ideas, then the alleged *source* of most G-Waves (i.e., black holes) is surely highly questionable, and therefore also the G-Waves themselves. Concerning G-Waves themselves, we question some of their alleged characteristics, and how these characteristics came to be predicted by the founders of the subject (Albert Einstein, and others).

Following is a list of issues pertaining to the matter. The list is not numbered because the subjects are not necessarily discussed in order. Notice, however, that the first and the last item are the same: ***A logically drawn space-time diagram of the simultaneous movement of laser light and a G-Wave through a LIGO interferometer whose purpose is to demonstrate the detectability of G-Waves inevitably depicts instead nonsense, contradiction, and the impossibility of detecting any G-Wave signal.*** If a coherent and convincing diagram were possible, then why don't G-Wavists draw one? They never do. This fact, whose status as such will be discussed at length, is the *veritable nail in the coffin*, the most damning evidence against the whole LIGO enterprise. Rotonians think it is an enlightening exercise to study the rest of the story, to see how this fatal link fits in context:

- A logically drawn space-time diagram of the simultaneous movement of laser light and a G-Wave through a LIGO interferometer whose purpose is to demonstrate the detectability of G-Waves inevitably depicts instead nonsense, contradiction, and the impossibility of detecting any G-Wave signal.
- Analogy with electromagnetic waves; propagation speed
- Quadrupole formula
- Problem of motion
- Energy balance (conservation)
- Dopey stick and bead argument (Pirani, Bondi, Feynman)
- Choice of coordinates; proper length vs. coordinate length
- Pseudo-Tensor; TT (transverse traceless) gauge; static Minkowski background
- Existence, measurability; work is done, or not?
- Stiffness of space-time
- "Old light / new light" elephant shit (Saulson, Adhikari video, *et al*)
- Approximation methods: Post-Newton, Post-Minkowski, EOB, etc.
- Quantum gravity; gravitons
- Einstein, Infeld, Hoffmann paper; advanced, retarded waves, time's arrow
- Sociological factors and implications
- A logically drawn space-time diagram of the simultaneous movement of laser light and a G-Wave through a LIGO interferometer whose purpose is to demonstrate the detectability of G-Waves inevitably depicts instead nonsense, contradiction, and the impossibility of detecting any G-Wave signal.

To maximize comprehension and cogency of the spacetime diagram argument, we begin by discussing the famous analogy between gravitational waves and electromagnetic waves — especially the alleged equality of their propagation speeds. This will be followed by more foundational remarks concerning the role of analogies in physics. A first look at the spacetime diagram argument, in its graphic, mathematical, and physical import, follows; and launches us into other matters of

G-Wave physics, mathematics, observing strategies, and sociology. As noted above, the idea is to emphasize the *utter fatality* of the spacetime diagram argument for the whole LIGO enterprise.

Being convinced that something is fishy, we are compelled to address LIGO's most impressive trick: Their allegation to have measured the gravitational wave corresponding to a nearly coincident burst of electromagnetic waves. It is crucial to point out that the trick *begins* with a huge cloud of smoke: a "glitch" that is used as an excuse for why LIGO did not *initiate* the ensuing flurry of observations of the gamma ray burst GRB 170817A and its aftermath. The hoax hypothesis maintains that LIGO contributed *nothing* of scientific value to the actually useful observations, which are all of an electromagnetic — not gravitational — wave nature.

We close with some speculations as to the possible culprits in the caper, and suggestions for coming clean and *staying* clean, moving forward.

2. The Speed of Light or the Speed of Thought?

> *Intriguingly, it seems that Einstein's first reaction on the completion of his theory was to conclude that gravitational waves do not exist.*
>
> Daniel Kennefick : *Traveling at the Speed of Thought* (2007) [6]

The title of Kennefick's book referred to above, is borrowed from the illustrious mid 20th century astrophysicist Sir Arthur Stanley Eddington, more of whose comments will be presented below. We follow Kennefick's train of thought in explaining why Einstein initially thought G-Waves do not exist. As quoted by Kennefick, in a letter to Karl Schwarzschild, Einstein wrote: "There are no gravitational waves analogous to light waves. This probably is also related to the one-sidedness of the sign of scalar T." Continuing his explanation, Kennefick writes:

> Einstein . . . realized that there was no such thing as a "gravitational dipole." He deduced this from the well-known fact that there are no negative masses in nature in the way that both negative and positive electric charges exist. There is only one pole to the gravitational force, attraction between masses; there is no such thing as repulsion, or antigravity. The "one-sidedness of the sign of scalar T" refers to the fact that there are no negative masses in the universe. [6]

After expounding on various ramifications of Einstein's statement — including its mathematical expression — 10 pages later Kennefick comes back to the upshot:

> Einstein seems to have guessed . . . that the absence of gravitational radiation from the theory might be connected to one obvious breakdown in the analogy with the electromagnetic force: the nonexistence of a push companion to the gravitational pull; that is to say, the fact that no negative masses exist which might produce an antigravity effect on ordinary mass.
>
> Therefore, we see that the question of whether gravitational waves existed was one of the first questions addressed by Einstein after he completed his theory. In this we can see the *suggestiveness of the analogy with the electromagnetic field*, but we also see that Einstein's response was skeptical. Gravitational waves do not exist, he decided, and he speculated that the reason lay in the *incompleteness of the analogy between the two field theories*. [6] [Emphasis added.]

Einstein changed his mind about the existence of G-Waves more than once. Within months of the assessment stated above — motivated by correspondence with Willem deSitter — Einstein reconsidered the possibility that his theory predicts G-Waves by appeal to a new mathematical approach. deSitter showed Einstein a new coordinate system (known as "isotropic" coordinates) for analyzing the problem. Unlike the coordinate system with which Einstein began his exploration, isotropic (and also "harmonic") coordinates are more conducive to the existence of G-Waves. In 1918 Einstein derived an equation called the *quadrupole formula* that is commonly regarded as the first sound basis for expecting G-Waves to exist. Einstein's analysis contained a factor of two error, which was found and fixed a few years later by the next character in our drama.

Enter A. S. Eddington, one of the first aficionados of GR. (Eddington's expedition to Africa to observe the 1919 eclipse, is what launched Einstein to fame. Eddington gathered data that showed Einstein's theory to be more accurate than Newton's by observing the stars near the limb of the Sun, as made possible by the eclipse.) Much as Eddington was a fan of Einstein and his new theory, he harbored some reservations about G-Waves. As Kennefick writes: "Eddington reasoned [that] Einstein had tended to *presume* that gravitational waves would propagate at speed *c* . . . Einstein's method . . . seemed to him to presume the speed of gravity in advance." The source for this assessment is Eddington's 1923 textbook on GR called *The Mathematical Theory of Relativity*. In this book Eddington writes:

> The statement that in the relativity theory gravitational waves are propagated with the speed of light . . . is only true in a very conventional sense. If coordinates are chosen so as to satisfy a certain condition which has no very clear geometrical importance, the speed is that of light. . . . So far as can be judged, the coordinates here used were purposely introduced in order to obtain the *simplification* which results from representing the propagation as occurring with the speed of light. *The argument thus follows a vicious circle.* [7] [Emphasis added.]

LIGOists in particular and relativists in general have not yet worked their way out of this vicious circle. Instead, with all manner of dubious rationales and justifications, they have etched it deeper and deeper into their psyches.

Why do Rotonians suspect a problem? Here's the thing. The speed of electromagnetic waves, i.e., *light* was theoretically deduced to be what it is by James Clerk Maxwell. In his theory of electromagnetism two fundamental, empirically derived constants: ϵ_o and μ_o, the *electric permittivity* and *magnetic permeability*, respectively, combine to give the vacuum speed of light waves. From Maxwell's 1865 theory it follows, specifically:

$$c = \frac{1}{\sqrt{\epsilon_o \mu_o}} \,. \tag{1}$$

GR appeals to no corresponding base properties or constants of physics or gravitational spacetime by which the speed for G-waves can be predicted and calculated. There is no corresponding *physical* reason why gravitational waves should travel at this same speed. The prediction that G-waves travel at the speed *c* is only a convenient *guess*. The overwhelming bulk of more than a century's theoretical work on G-Waves has "presumed" this guess to be correct. Rotonians strongly suspect it is not.

However questionable it may be that G-Waves travel at the *speed of light*, it must be acknowledged that the effects of gravity surely require *some* speed of propagation. Perhaps the most common thought example is to imagine the sudden disappearance of the Sun. Would we on Earth be able to measure this disappearance (e.g., measure that Earth's path was suddenly straight instead of elliptical) only at that moment when the last *light* rays of the Sun reached us? Rotonians suspect that the

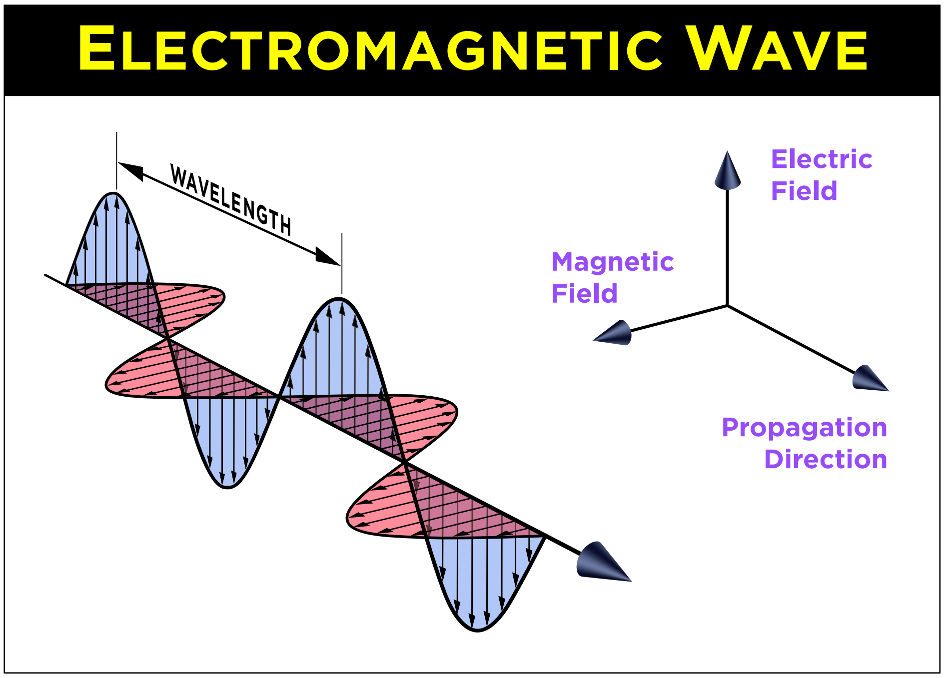


Fig. 1. **Complex Light Wave Structure:** Why should G-Waves travel at the same speed as electromagnetic waves? The latter waves involve the perpendicular relationship between electricity and magnetism in an endless leap-frogging dance whose relationship to gravity is unknown. There is no good *physical* reason for this lazy guess of convenience.

sudden absence of the Sun's gravity would be detectable sooner. In their working model of gravity (see **Part 2**) removing the Sun's gravity does not simply mean removing the seemingly discontinuous fiery ball itself. The Sun's matter *comes with* a proportional amount of space—surrounding and occupied by the Sun's material body. Surely the idea of suddenly removing the Sun entails imagining the just as sudden non-existence of the space it is responsible for (i.e., it is the source of). In any case—independent of this hypothesis—the hunch that the propagation of gravitational effects occurs with a *different speed* than that of light is implicitly recognized by at least one well-respected modern gravitational theorist, Anthony Zee. In his 866-page tome called *Einstein Gravity in a Nutshell*, Zee writes:

> The naturalness dogma [of modern particle theorists says that] fundamental constants with the same dimension should have roughly the same order of magnitude . . . We now understand that the speed of propagation is a universal constant . . . But before this understanding, ***it would seem strange, perhaps even bizarre***, that gravitational and electromagnetic waves would propagate at precisely the same speed c. [8] [Emphasis added.]

Having never been followers of the "naturalness dogma," Rotonians, instinctively maintain the less "strange," the less "bizarre" suspicion that the speed of G-Waves is something other than c.

Whatever the speed of gravity may be, it is considerably more complicated to conceive the physical effects when considering not just the existence or non-existence of a *single* body, but *two* bodies revolving around each other. This problem has never been exactly solved in GR (nor any other theory according to which gravity's essence involves the curvature of spacetime). The extreme difficulty of GR's *two-body problem* is one of the key reasons for the complexity of this story.

Kennefick's implication that the analogy between gravity and electromagnetism would be more reasonable, more intuitive, if there were "negative masses" rings true. But Kennefick fails to make the even more important point that electromagnetism exhibits a kind of *double duality* that is most unlike gravity's singular character. (See Figure 1.) Electricity exhibits positive and negative charges; and magnetism exhibits "north" and "south" poles. Together electricity and magnetism $(+, -)$ / (N, S) engage in a distinctly more complicated dance than gravity — with its much simpler, monopolar behavior — ever could. It just doesn't make sense to expect that a characteristic *speed of gravity* should be the same as the characteristic *speed of light*. "Bizarre" nonsense is the less presumptuous, more sensible, dogma-free assessment of the prevailing assumption.

3. Analogies, Newton's Rules, Doldrum Decades, and the Binary Pulsar

> *You start thinking by the use of analogy. Analogy is not the criterion of truth; it is an instrument of creation, and the sign of the effort of human minds to cope with something novel, something fresh, something unexpected . . . **The notion of analogy is deeper than the notion of formulae** . . . Analogies play, in the relation between sciences, a very great part, sometimes a harmful one.*
>
> J. Robert Oppenheimer : (1957) [Emphasis added.] [9]

It will be useful to consider some of the history of G-Wave research from the decades following Einstein and Eddington's early work. During this time, ca. 1920–1960, interest in GR was experiencing a lull (as explained by Kennefick and many other historians of science) at least partly due to the increased interest in the exciting developments taking place in quantum theory. Before discussing a few elements of that "checkered" course of events, it is pertinent to first acknowledge that, however intermittent, and of mixed value, the efforts ultimately *seemed to* bear fruit. Since the late 1970s, observations of the famous Hulse and Taylor binary pulsar PSR B1913+16 have provided increasingly convincing support for Einstein's quadrupole formula, predicting that the star system would lose energy, corresponding to the emission of G-Waves. (See Figure 2.)

Insofar as the story of G-Waves is infused with (or even dominated by) appeals to analogy, let us consider in more depth Oppenheimer's thoughts (opening quote) on the use of analogy in gravitational physics. The new binary pulsar evidence establishes convincing support for Einstein's quadrupole formula with regard to orbital energy-damping. As for the questions of the *existence* and the *speed* of G-Waves, should we be correspondingly convinced? Is the analogy with electromagnetic radiation validated in this regard, or not?

As "instruments of creation" *analogies* are invented by humans to facilitate understanding. In order to avoid having these instruments become "harmful ones," to avoid *mis*understandings, due diligence is often needed to discover their limits. Two different phenomena are not the same phenomena, so every analogy breaks down somewhere. Analogies are subject to misinterpretation, to the possibility of faulty connections and illusory parallels based on entrenched preconceptions.

In physics we need to ask: which parts of an analogy ring true and are applicable from one domain to another? Which parts are directly testable? Which parts have *no counterparts* and are not applicable at all? Which parts are only *assumed* to apply and are beyond the reach of *direct* testing?

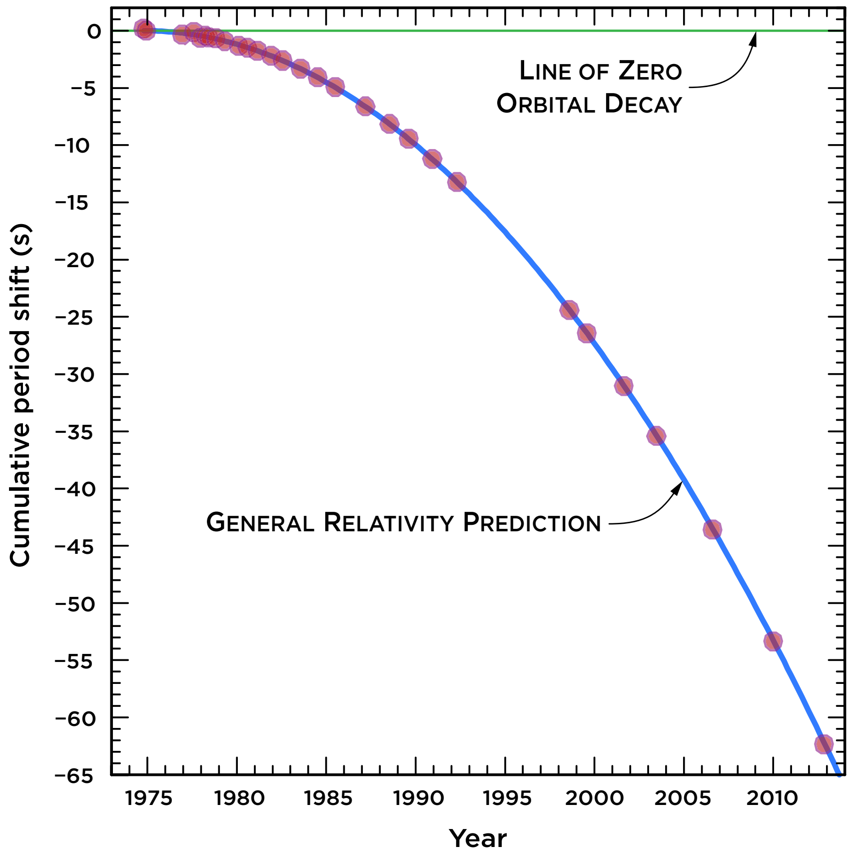


Figure 3. The orbital decay of PSR B1913+16 as a function of time. The curve represents the orbital phase shift expected from gravitational wave emission according to General Relativity. The points, with error bars too small to show, represent our measurements.

Fig. 2. **Binary Pulsar PSR B1913+16 :** First observed by Hulse and Taylor in 1974, the more recent observations by J. M. Weisberg and Y. Huang confirm and extend the pattern. Although the decay of the orbit provides impressive support for the curvature of spacetime (quadrupole formula) predicted by GR, this is emphatically *not* definitive evidence for the existence of G-Waves. [10]

In cosmology, for example, is the redshift of distant galaxies really analogous to the Doppler effect? Edwin Hubble suspected it was not. Maybe galaxies do not actually recede from one another, forever opening more distance between them. Rotonians agree with Hubble. Unfortunately, a large community of scholars (Big Bangists) have not only ignored Hubble's actual opinion, they claim his observations support this highly questionable, perhaps even harmful analogy.

Upon contemplating the dimensionality of space, a common instructional tool involves invoking an imaginary world of two-dimensional creatures. Their relationship to our world of three spatial dimensions is imagined as being analogous to the relationship between our world and the world of beings of a hypothetical, even higher-dimensional existence. Which parts of these oft-encountered analogies are misguided mathematical abstractions, and which parts are applicable to the physical world, conducive to *testing* with physical experiments? The Rotonian perspective provides a new, arguably more coherent answer to these inter-dimensional questions. (See **Part 2**, §5.7–5.8.)

Upon contemplating the Einstein-inspired *curvature of spacetime*, we appeal to the analogous similarities between physical effects (both gross and subtle) found on uniformly *rotating* bodies and *gravitating* bodies. Is not the dangerous, harmful idea to conclude, because of these similarities, that *rotating observers have the right to think of themselves as being at rest*? This is the conclusion Einstein reached, supposedly because we at Earth's surface are "obviously" at rest. To the Rotonians' dismay, this arguably misguided approach is the one promoted by Einstein, and adopted by a throng of followers.

It is pertinent to point out that Einstein's logic conflicts with ***Newton's Rules of Reasoning in Philosophy***, wherein it is stated:

> Nature does nothing in vain, and more is in vain when less will serve; for Nature is pleased with simplicity, and affects not the pomp of superfluous causes . . . Therefore to the same natural effects we must, as far as possible, assign the same causes. [11]

Einstein's claim that rotating observers are justified to think of themselves as being at rest is *patently absurd*. This perspective is so extreme that it requires the whole rest of the Universe to be rotating in the opposite direction for every different observer, rotating with all different speeds and directions. ***Totally nuts!*** Was Einstein's motivation to rack up points for boldness? He missed his chance to invert the analogy to the obvious alternative — the alternative that is consistent with *Newton's Rules*. Effects that are attributable to the *absoluteness of rotational motion*, being also found on and near gravitating bodies, imply that *gravitating bodies are also in motion, not static*. Assigning the *same causes to the same effects* evidently means that gravitating bodies are also undergoing a kind of *perpetual, stationary motion*. If not yet to any human physicist, then certainly to the Rotonians, this is far and away the more sensible interpretation of this undeniably potent analogy.

Upon contemplating the equal falling of material bodies and the flattening of our undersides on Earth and the analogous circumstances inside a uniformly accelerating rocket (Equivalence Principle) is not the dangerous, harmful idea to conclude, based on these similarities, that rocket-propelled observers have the right to regard themselves as being *at rest*? Should we not at least hesitate upon reaching this bizarre conclusion that *rest* and *acceleration* should become so scrambled up as physical concepts? Are we not obliged as physicists to instead suspect that our eyes may be deceiving us and that we should perhaps instead believe our *tactile* motion-sensing devices (accelerometers)? Maybe accelerometers always tell the physical truth about their state of motion. We are ill-advised to scramble the concepts of rest and acceleration because *there is ultimately no such thing as a "state of rest."* Might it actually be true that non-zero accelerometer readings *ALWAYS* indicate physically real non-zero accelerations?

Analogies motivate these questions. The answers lie not in our preconception-filled brains. They lie in *Nature*. In the present case (gravity) Rotonians guess that the answers lie under a prominent stone smack dab in the middle of the garden of physics: *inside* every body of matter. Out of blind allegiance to authority, Earthian physicists refuse to look under this stone. They refuse to build and operate humanity's first ***Small Low-Energy Non-Collider***. Entrenched theories tell us that we already know what we'd find if we did actually look. Seemingly out of *fear* of offending the gods of this entrenchment, rigorously trained physicists merely ***pretend*** *to know*. They only ***pretend*** to know the result of the experiment proposed by Galileo 391 years ago — the experiment that remains tragically undone. Compounding their grave error, physicists are totally committed to this presumed "knowledge." The prevailing edifice of physics would crumble if the prevailing guess as to the result of Galileo's experiment were shown to be incorrect. Such is the potential harm, the seriously tragic harm, that insufficiently researched analogies can cause.

4. Graphically Juxtaposed G-Waves and Light Beams

> *This can't be right. It's just like those first simulations. Someone did a blind injection and they stupidly just took the most obvious thing that was available.*
>
> J. FRANS PRETORIUS : G-Wave Numerical Relativist : (2016) [12]

4˙1. *Minkowski Diagram: G-Wavists' Missing Illustration*

In this and following Sections we tentatively grant as being correct the standard assumption that the speed of gravity equals the speed of light. Our argument is all the more weighty because using only standard assumptions and standard descriptions of the alleged behavior of G-Waves, it becomes obvious that LIGO would never be able to detect them.

If LIGO has never detected a G-Wave, the question becomes what then explains LIGOists' claims of observation? What do their reported data actually represent? A fact that we'll discuss in more detail later is alluded to in the above quote by J. Frans Pretorius. LIGO was designed to facilitate cheating. It was designed with the capacity for a select group of administrators to be able to surreptitiously "inject" fake signals into the system for the purpose of mimicking real astrophysical signals. Echoing the comment by Pretorius, upon seeing the initial results of LIGO's first observation, Nobel Laureate, Rainer Weiss admitted:

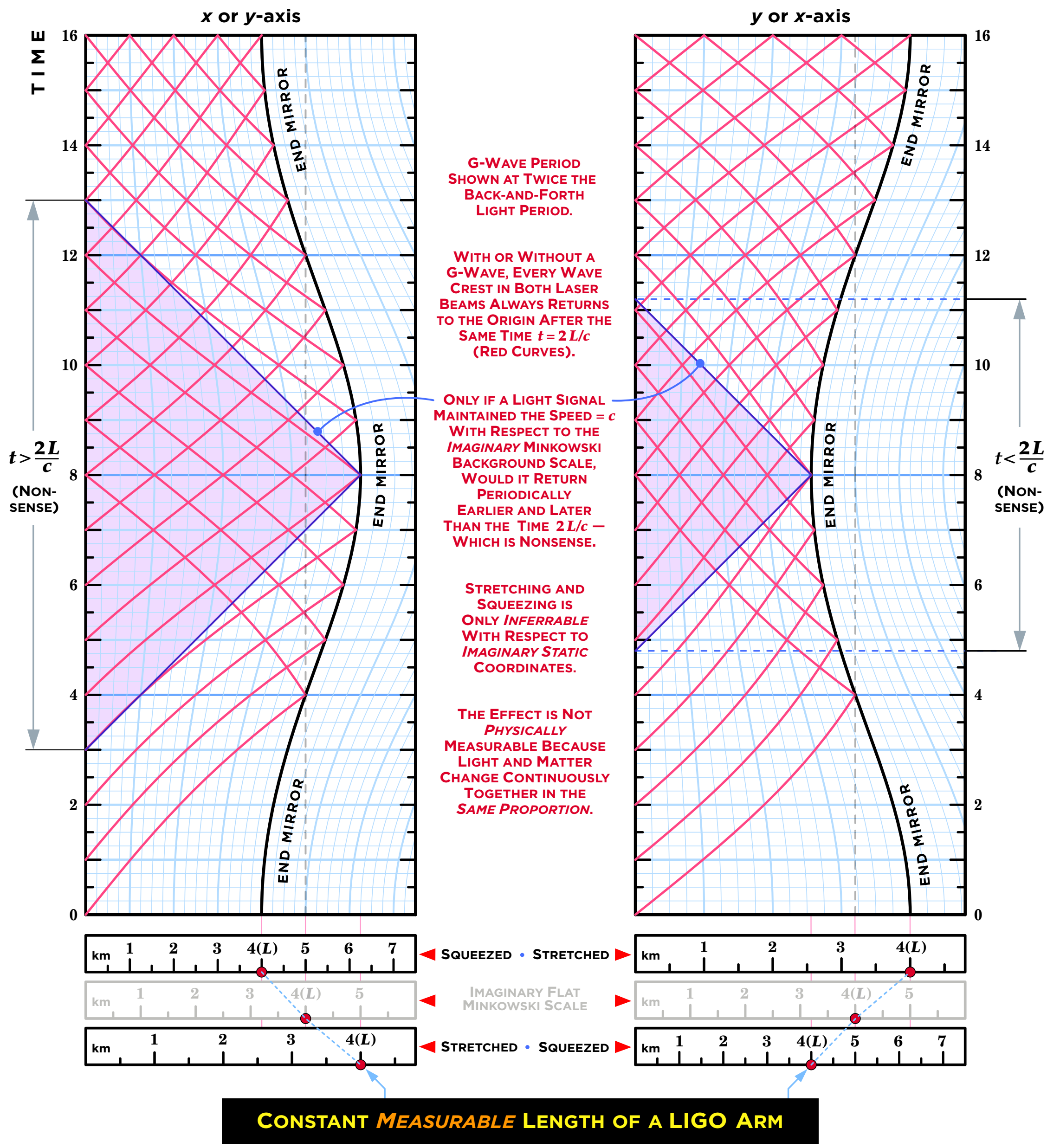
> The first thought that *ALL* of us had — I mean every one of us — was that it was a blind injection . . . It looked just too good. [13]

The *means* to carry out a hoax was thus intentionally built into the system. Rotonians suspect that all reports of G-Wave observations were either blind (or "malicious") injections, or statistical flukes (the latter being far less likely possibilities). If real G-Waves exist, they are not actually measurable. To my knowledge, the most comprehensive account of the inner workings of LIGO that attempts to downplay the likelihood of injected signals, is sociologist Harry Collins's 2017 book, *Gravity's Kiss*. [14] Interested readers are urged to assess that abundantly detailed account. By contrast, Rotonians infer the contrary conclusion that, compared to *injected* signals, *real* G-Wave signals are even less likely (virtually *impossible*). Our assessment rests, as stated earlier, almost entirely on *graphic* evidence — or lack thereof.

The drawings that LIGOists, G-Wavists and General Relativists have never gotten around to creating are ones like our Figures 3 and 4. The idea is to visualize laser beams and G-Waves traveling simultaneously through LIGO's interferometers. Laser beams have precisely controlled wavelengths, and travel at the speed of light. G-Waves affect all matter and all space, alternately stretching and compressing the whole continuum. These phenomena and effects are very conducive to graphic representation. But LIGOists utterly fail to think in graphic terms; they do not even try to make a spacetime diagram (aka Minkowski diagram) of what their apparatus is supposed to do, what it is supposed to see.

To my knowledge, there was only *one* similar (only *inadequately* similar) exception — that being a diagram whose resemblance to ours turns into an incoherent mess because it tries to accommodate the *contradictory* elements espoused in the literature about how the LIGO interferometers are supposed to work. For some unknown reason, the internet link to the figure on physicist William

G-Wave and Light Waves Juxtaposed in Space and Time



"If the arms are stretched, then the light is stretched. The arms of an interferometer are lengthened by a gravitational wave. ***The wavelength of the light in an interferometer is also lengthened by a gravitational wave, by the same factor.***" —

PETER SAULSON,
VETERAN LIGO PHYSICIST (2018)

The above diagrams illustrate Saulson's description.

Saulson and his fellow G-Wavists could draw such a diagram themselves. Why don't they?

That is the $$$ billion dollar question.

(Caption on Next Page)

Fig. 3. **G-Wave-Induced Perpendicular Stretching and Squeezing of Spacetime**. The curved black lines indicate the end of an interferometer arm whose *proper distance* from the origin L, remains 4 km, as measured by a tape measure whose length changes in the same proportion. (See discussion in the text concerning confusion and inconsistencies in the meaning of *proper length* and *coordinate length*, as found in the GR literature.) The scale is exaggerated so that the time for a light beam to reflect back and forth is 1/2 the period of the G-wave. The vertical axis is Time in arbitrary units. The periods of G-Waves claimed to have been observed by LIGOists are actually many times greater than the back-and-forth light period, so that a more realistic diagram would involve compressing the time axis by a factor of 100 or so (which would make the angle of light rays nearly horizontal). Our choice of scale, though unrealistic, maximizes graphic/heuristic clarity and is nevertheless physically accurate *in principle*. LEFT and RIGHT sides correspond to half-period (π-separated) G-Wave phases along the perpendicular axes, assuming an incoming G-Wave perpendicular to the plane of the page. (When the x-arm is stretched, the y-arm is squeezed, and vice versa.)

Curvature of the grid represents a changing strain $h = \Delta L/L$ (grossly exaggerated) that we conceive as a G-Wave-caused ***scale change***, as expected for a LIGO arm. In the absence of a G-Wave, light paths would be straight 45° (flat Minkowski) diagonals. The curvy red lines indicate light paths that undergo the same stretching and squeezing as the interferometer arms (as is often described by LIGOists; e.g., Peter Saulson). Light speed $= c$ because the light wave is affected in the same proportion as the material arms, as shown. Illogically, LIGOists predict unequal return times (Δt) for perpendicular light paths, because they imagine light speed to $= c$ with respect to an ***imaginary*** static grid. The G-Wave-caused wobbling (h) is supposed to occur as against this abstractly conceived grid that does not wobble. Such wobbling can be ***calculated.*** But it is ***not physically measurable.*** A contradiction-free drawing of their Δt prediction is therefore not possible.

Due to the continuous stretching and squeezing of both matter and light, an interferometer like LIGO would yield laser signal return times that are *always* $t = 2L/c$ for any x or y distance (where L is measured by the same tape measure mentioned above). This means that LIGO is actually incapable of "observing" G-Waves. More likely than any flaw in our Figure and the reasoning that supports it, is that the whole LIGO enterprise is a hoax. See also Figure 4.

Andersen's webpage — functional a few years ago — no longer works. Our Figure 5, based on Andersen's figure is a somewhat cleaned up remake his Figure 2, the closest thing I know of to a published version of Figure 3 (not very close at all). [15]

Andersen promises "to answer the question how gravitational wave interferometric detectors can detect gravitational waves given that both the wavelength and interferometer arm would be stretched by the same fraction." As we will later see, this bothersome thorn of a question has sometimes been referred to as the ***Rubber Ruler Puzzle***. It is also the question flippantly uttered in our opening quote (p. 1) by Rana Adhikari: "If **everything** is stretching . . . how do you know **anything** is stretching? That's the conundrum. It doesn't make any sense!" Andersen's drawing only compounds the nonsense. It backfires, which is why no other physicist, to my knowledge dares to publish it. For archival and educational purposes, it is fortunate that I downloaded Andersen's brief document before links on his web page went dark. As we will later see, among the contradictory *verbal* descriptions of how a LIGO interferometer is supposed to work are those that might "inspire" a drawing like Andersen's. This is but one of the many junctures in this discussion at which it is appropriate to echo Adhikari's assessment: "It doesn't make any sense!"

Note, in particular, that the grid underlying Andersen's light rays increases in spatial size (suddenly at $t = 4$) by *adding* grid squares. This is not "stretching" (neither as interferometer arms nor as a measurement grid, nor as light waves). It is *adding* to what's already there. This crucial difference is also clearly illustrated in Figure 4. "Stretching by the same fraction" means *multiplying* the size of the existing grid separations as a *scale factor*, not adding tick marks to or subtracting them from the existing scale. The result of *stretching* would be that the grid retains *the same number of divisions* — and the light beam would contain the same number of wave crests — even though their

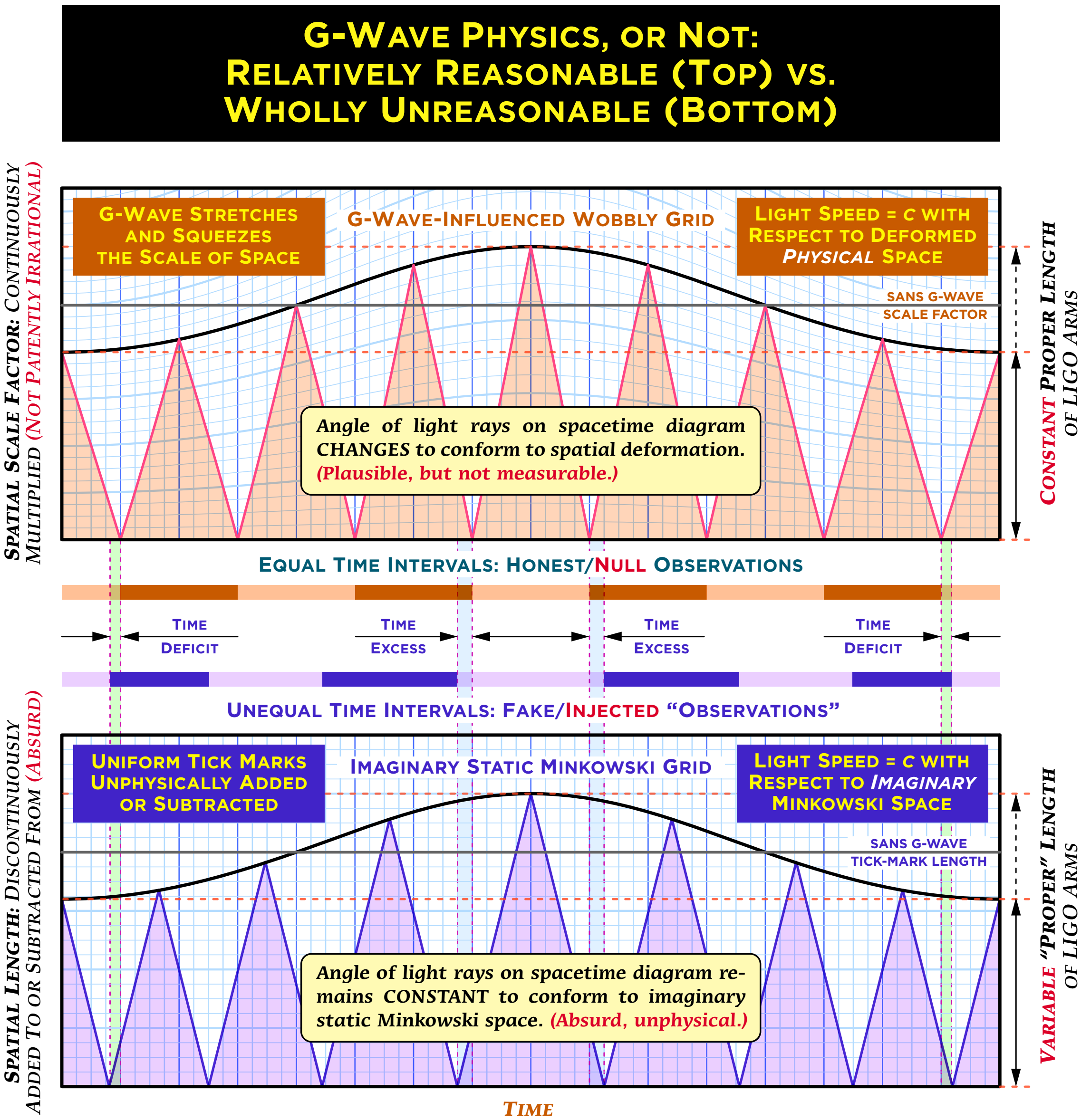


Fig. 4. **Everything Wobbles:** Similar to Figure 3, the graph is now rotated 90° and the time scale is compressed by a factor of four. This makes it one step closer to the actual ratio between typical G-Wave periods and the optical circuit period of the LIGO interferometer. Top. — Though the effect of a G-Wave wobble is ***calculable***, it is ***not observable***. There is no physically unwobbled scale to use as a standard of measurement. Bottom. — The accepted interpretation purports, in effect, that the speed of light remains $= c$ with respect to an ***imaginary*** static grid (Minkowski space). A passing G-Wave supposedly causes the number of Minkowski space tick marks between the ends of LIGO's arm to alternately increase or decrease so that the time–of–flight of reflecting laser beams fluctuates correspondingly. ***This is delusional thinking.*** G-Wave or not, the time for a laser beam to reflect back and forth between mirrors is always $t = 2L/c$, as shown at the Top, because ***Everything Wobbles.*** That's what it ***means*** to say, as Peter Saulson has: "The arms of an interferometer are lengthened by a gravitational wave. The wavelength of the light in an interferometer is also lengthened by a gravitational wave, by the same factor." LIGOism is the gaslit disease whereby physicists pretend to not believe their own words. It's a very serious, very expensive malady.

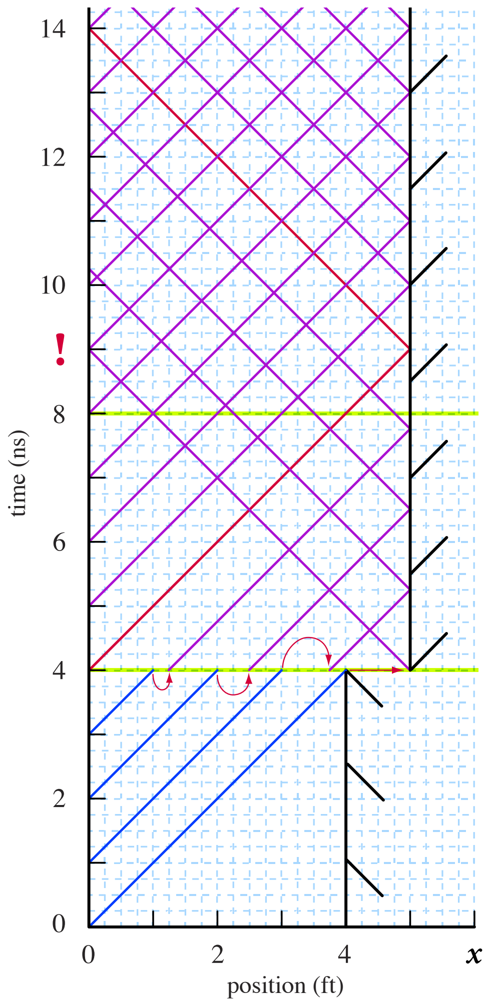


FIG. 2: Lines of constant phase in spacetime. The beam-splitter is at $x = 0$ and a mirror at $x = 4$ ft. A Heaviside gravitational wave hits at 4 ns. It is important to note that the horizontal axis represents physical distance from $x = 0$ rather than coordinate distance.

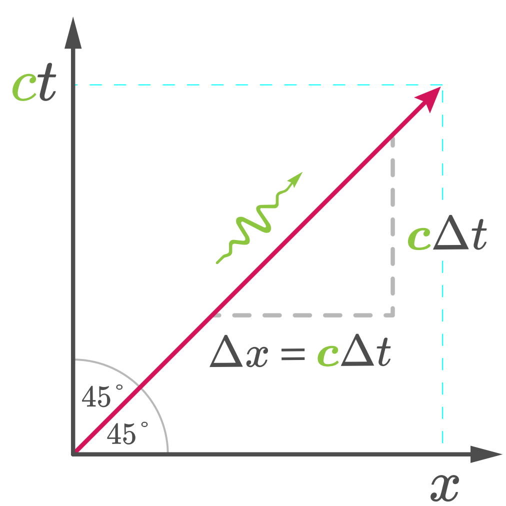
Fig. 5. **Andersen's Absurd Spacetime Diagram for Interferometer-Traversing G-Waves:** In order to make light beams emitted at or after $t = 0$ take *longer* than the time $2x/c = 8$ to return, the author invokes magical mirror motion and infinite light speed (at $t = 4$). An exclamation point indicates the first of the series of late-arriving beams. Arrows (that Andersen also drew into his original diagram) indicate the magical jump. The words *physical distance* and *coordinate distance* are colored red for reasons discussed in the text. Most absurd is the *staticness* of Andersen's background grid, which is obviously not physical, but only mental, because it is left unaffected by the passing G-Wave. As though the G-Wave adds "physical" tick marks to the length of the arm, from four to five units. Totally absurd. [15]

right-most endpoints are further from the origin. If this were the case, we'd see the light beam that starts out at $t = 0$ return at the time $t = 8$, not a moment sooner or later. In other words, we'd get diagrams more like our Figures 3 and the TOP of Figure 4, which show that the time for the laser beam to return to the beam splitter is always the same—with or without a G-Wave. The question is, why are physicists so sloppy in pretending to deliver what they don't really deliver? Who is convinced by Andersen's ridiculous drawing (or verbal descriptions of it)? And why?

Our patently more logical Figure 3 and the TOP of Figure 4 represent the passing of a G-Wave through the plane of the page by the gently curving mirror position line and stretched and squeezed coordinate grid. Without the G-Wave, we'd simply have stationary mirror positions on a rectilinear grid, and rigid 45° light rays, as in more typical spacetime diagrams. The basic structure of our figures and the fact that the physical phenomena they represent are *simple*, and drawn according to many *verbal descriptions* found in the literature, suggests that if they are somehow incorrect, then they can still be used as a basis for making needed adjustments. A G-Wave passing through an interferometer is surely to be drawn at least *something like* Figures 3 and 4. The *framework* upon which the figures is based, as prominently displayed therein, is *common* and arises in many discussions concerning the physics and mathematics of Relativity, which therefore makes it worthy of further discussion.

4˙2. *Light Clocks: Callister's First Step*

Among various examples of *first steps* toward using a spacetime diagram to represent the interferometer setup of LIGO is one found in the 2020 Caltech *PhD Thesis* of Thomas A. Callister, III. The text that accompanies Callister's figure helps to clarify the LIGOist rationale and strategy. Before presenting Callister's figure and extracting a long quote from his *Thesis*, however, a few terms and ideas found therein should be explained first. For example, the concepts of *proper length* and *coordinate length*. Since their meanings have morphed from what they used to mean in the context of elementary discussions of GR's Schwarzschild geometry, it will be useful to lead up to our extract of Callister's work as follows.



A **worldline of a light particle** sketched in a Minkowski diagram (space-time diagram). Scale of the axes is chosen so that the photon's worldline is an *angle bisector.* That means: the worldlines of light particles (photons) include same angle with the position axis, as with the time axis. All physically possible worldlines are always steeper than the photon worldlines.

Fig. 6. **Basic Spacetime Diagram:** The physics and geometry of light beams in flat (Minkowski) space are often clarified by use of the ubiquitous heuristic device illustrated here. [16]

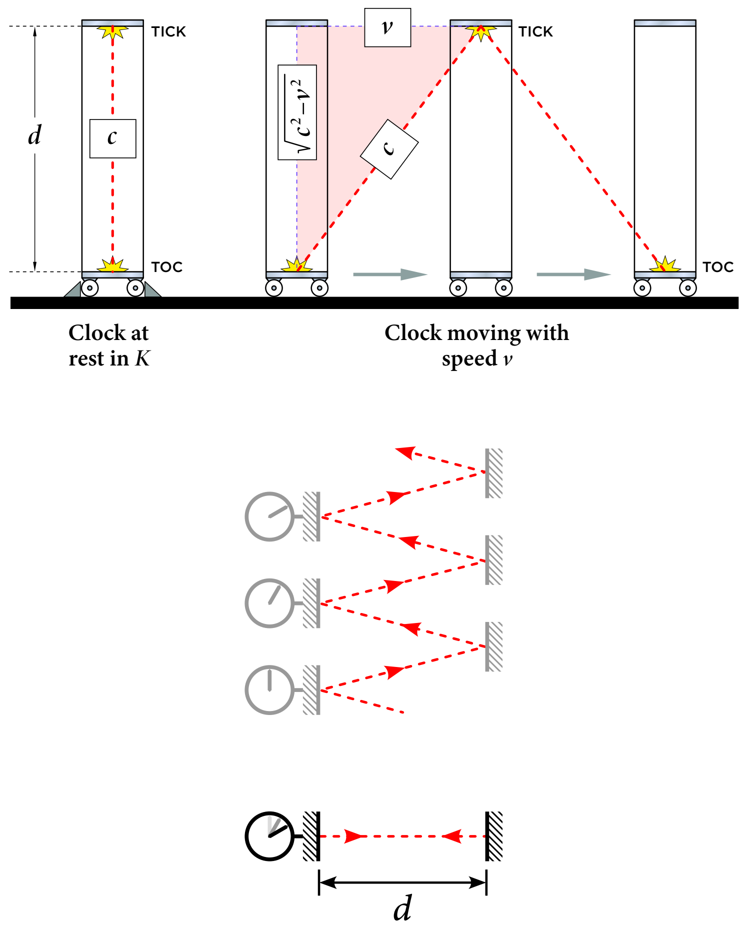


Fig. 7. **Basic Light Clocks:** Often used for illustrating time dilation (TOP), light clocks are also shown here with back and forth paths corresponding to ticks on a more traditional clock (BOTTOM). [17]

For the benefit of those who could use a refresher in such matters, we start at a basic level. We build up the logic of light clocks, spacetime (aka *Minkowski*) diagrams, proper lengths, coordinate lengths, and eventually bring in the key characteristics of G-Waves, which are in principle rather simple things.

A spacetime or Minkowski diagram, is a graph that represents spatial distances on the abscissa (x-axis) and time intervals on the ordinate (y-axis). Time differences are typically multiplied by the speed of light c, which gives them the dimensions of length. A line emanating from the origin or the time axis at a 45° angle is therefore a light ray on the diagram. See Figure 6.

Another common heuristic device in elementary relativity discussion is a *light clock*. Light clocks are often used to facilitate understanding time dilation for moving clocks, but also serve as examples of idealized time-keeping devices. Their basic geometry is the same as that of the LIGO arms, with their terminally situated mirror systems. For a continuous light source like a laser beam, time keeping is made more robust when a well-defined disruption in the otherwise continuous light wave repeats at regular intervals as "ticks" (or tocks) of the clock. See Figure 7.

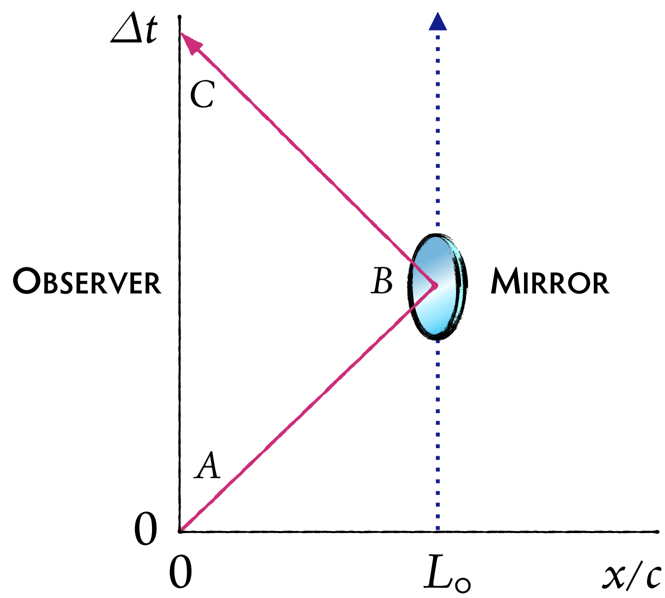


Figure 2.1: Spacetime diagram of the time-of-flight experiment carried out by our ambitious physics student. The student, at coordinate position $x = 0$, hangs a mirror at position $x = L_0$. At time $t = 0$ she then shoots a pulse of light at the mirror, recording the time Δt at which the pulse returns to her.

Fig. 8. **Thomas A. Callister, III Sets Up a G-Wave Light Beam Experiment:** In Callister's 2020 Caltech *PhD Thesis*, he presents the beginning of a LIGO light-clock experiment. In the accompanying text, his scenario continues by supposing that a G-Wave impinges on the device perpendicular to the plane of the page. But he fails to actually draw out what would then happen to his mirror system. Rather, he lamely deflects, saying it could be "the source of much confusion," and refers his readers to other authorities who similarly botch the story and fail to draw a sensible picture. [18]

In the absence of such prominent ticks, interferometers can yield clues about time and space by splitting a light beam in two, redirecting them to travel on perpendicular paths, and then recombining them to measure the interference pattern. It's a very tricky business when the objective is to measure changes in the pattern that are on the order of 10^{-20}. Does the pattern indicate changes in space, time, speed, noise, or what? In any case, The bottom of Figure 7 gives an idea of how a light ray bouncing back and forth across a fixed optical path translates into the motion of hands on a more traditional clock. And Figure 8 is one of many examples of the beginning of a woefully incomplete graph presented by a G-Wavist who starts the job but leaves it unfinished.

4·3. *Proper vs. Coordinate*

It is sometimes pointed out that G-Waves alter spatial distances, but do not affect the rates of clocks. [19] We can see this in the fact that the (alleged) observation of G-Waves involves only a single clock at the origin (as in Figures 7 or 8), not two different, spatially separated clocks. Also in

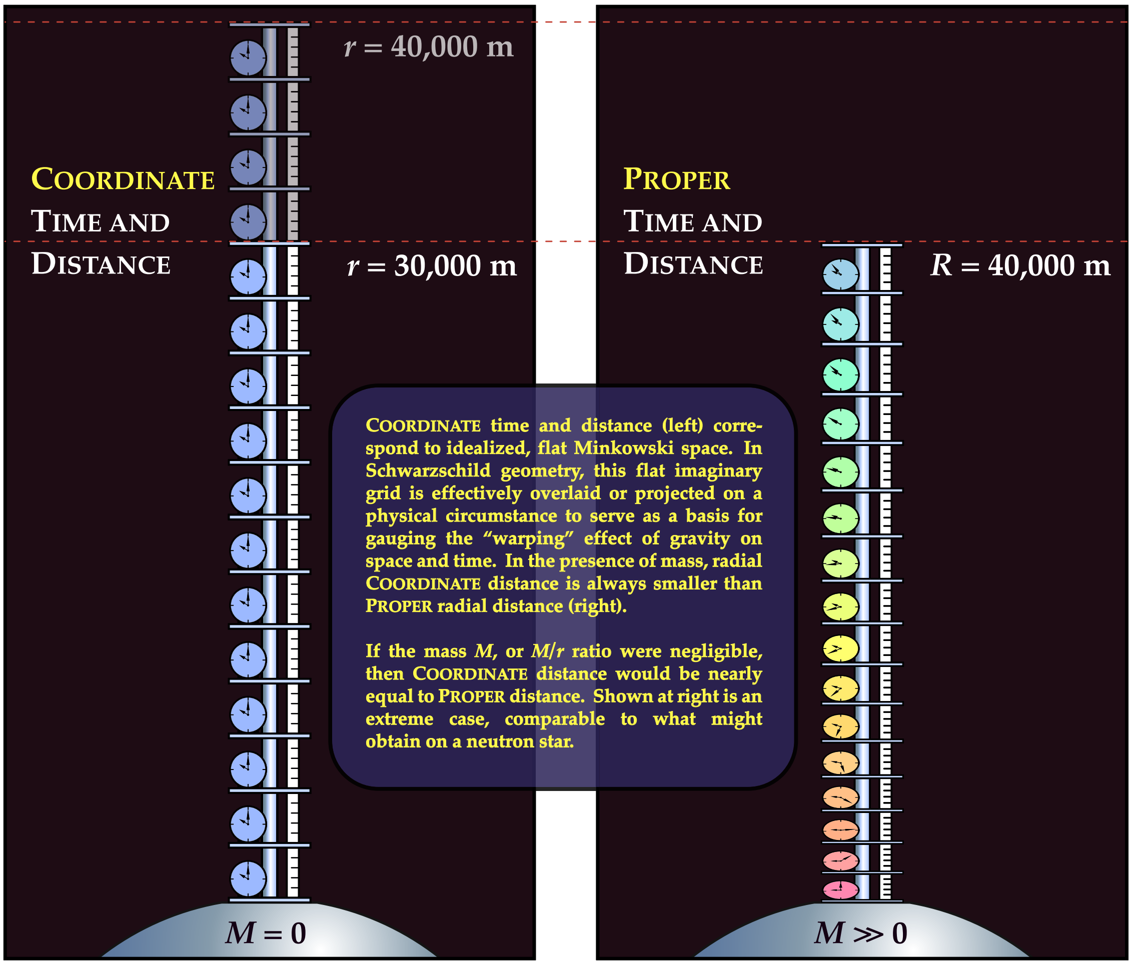


Fig. 9. **Coordinate vs Proper Quantities in Schwarzschild Geometry:** LEFT — Regardless of radial distance from an *imaginary* massless body, as in perfectly flat Minkowski space, *coordinate* clock rates and rod lengths of observers at rest with respect to this body are the same everywhere. Clock rate is an effective maximum (as indicated by the identically colored blue clocks); and all measuring rods have identical lengths, as shown. "Measurements" conceived as being made with these imaginary tools refer to *coordinate times* and *coordinate distances*. RIGHT—A massive body's effect on clocks and rods (by virtue of its gravity) is to cause a range of clock rates (frequencies) — as indicated by the spectrum of clock colors — and to contract radial rod lengths, the more so the closer they are to the body's surface. Measurements made with the latter tools by *proper* observers in the field are called *proper times* and *proper distances*; sometimes *actual* times and distances.

Callister's diagram (Figure 8) and text (as we will momentarily see) the crucial data is gotten by a single observer at the origin who "records the time Δt at which the pulse returns to her." Even if there were a second clock located at the far end of the LIGO arm, since both of them are held fixed at the same height, they keep the same time.

Now let's address the difference between *proper* quantities and *coordinate* quantities. The difference comes to light by considering pairs (or an array) of clocks that *do* keep different time. For example, consider a set of clocks (and other measuring devices) arrayed at different heights on a tall tower planted on the surface of a large gravitating body, as in Figure 9 (RIGHT). The time kept

126 4 Physics in the vicinity of a massive object

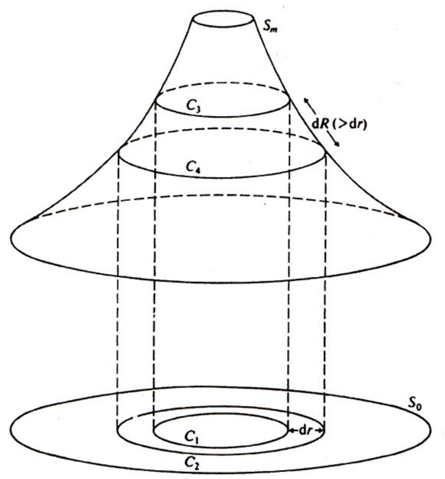


Fig. 4.1. Radial distance in the Schwarzschild geometry. Here $dR = f(r)dr$, where $f(r) = (1 - 2m/r)^{-1/2}$. The curve gives the value of $f(r)$, which tends to infinity as $r \to 2m$ and to unity as $r \to \infty$.

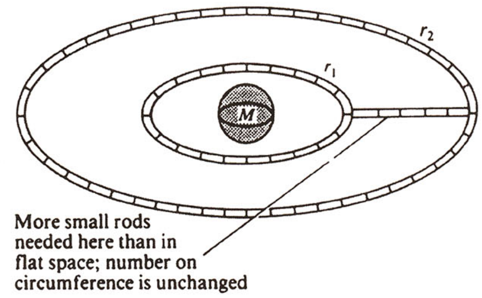


Fig. 4.2. Measuring distances in the Schwarzschild geometry. The circumferences of the circles are less than $2\pi R$.

Fig. 10. **Foster & Nightengale Diagrams on Schwarzschild Geometry:** These graphics are another way of communicating the idea of our Figure 9, with regard to radial distances as between *coordinate* "measurements" and *proper* measurements. [20]

by these clocks is referred to as *proper time*; it is the time kept by a local observer who carries or is alongside such a clock. All clocks fixed over the surface of a massive body tick slower than an idealized set of reference clocks (Left). The reference clocks are *imaginary*. Being uninfluenced by gravity, they are imagined to all tick at the same maximum rate — the same as a set of real clocks located at a ("nearly") infinite distance. The time kept by these clocks is called *coordinate time*.

Figure 9 illustrates the proper/coordinate relationship. On the right side, clock rate is represented by a color spectrum: from red (slower) near the surface, to blue (faster) high above the surface. Radial separation distances are marked out by rigid rulers. These distances, which are also measurable with light signals, represent the *proper lengths*. With regard to *spatial* measurements, the meaning of Figure 9 is essentially the same as that of Figure 10, which pairs together Figures 4.1 and 4.2 from a book called *Short Course in General Relativity* by Foster and Nightengale. [20] The equations that provide the basis for these figures,

(2)
$$dr = dR\sqrt{1 - \frac{2GM}{rc^2}} \qquad ; \qquad dt = \frac{d\tau}{\sqrt{1 - \frac{2GM}{rc^2}}} ,$$

also pertain to variations in the radial *coordinate speed of light*:

$$\frac{dr}{dt} = \pm c\left(1 - \frac{2GM}{rc^2}\right). \tag{3}$$

The authors explain that

> As $r \to \infty$, $dR \to dr$ so asymptotically the coordinate distance dr coincides with the *actual distance* dR, and the coordinate time dt with the *proper time* $d\tau$. [20] [Emphasis added.]

Notice that the authors refer to the *spatial* counterpart for proper time, not as *proper* length or *proper* distance, but as the *actual distance.* Unfortunate as this variation in nomenclature may be, we will encounter it again in what follows. It is a perennial feature of the mudfog that surrounds Einstein's Theory of Relativity. We are taking the trouble to sift our way through to the crucial ideas that endure and clarify. Notice that for a light ray, the ratio of *proper* quantities $dR/d\tau$ equals c. The speed of light that travels *actual* distances measured with *actual* (proper) clocks is always $= c$.

We emphasize that *proper length* is the distance that is *physically measurable by an observer in the field*, with perfectly constructed measuring rods, tape measure, or light signals. Whereas *coordinate distances* are those that are represented by the r-coordinate in the famous Schwarzschild solution. Coordinate lengths are thus the same as in flat Minkowski space (absence of gravity). When the Schwarzschild coefficient $(1 - 2GM/rc^2)$ equals 1, because $M = 0$, coordinate lengths are equal to proper lengths. But when $M > 0$, all radial coordinate distances are less than the corresponding proper distances. Massive bodies, in effect, add spatial distance, requiring more proper rods laid end-to-end between radially separated positions than the corresponding number of coordinate rods, as indicated in both Figures 9 and 10.

It is important to understand that the contraction of radial proper lengths *goes with* the ***proper*** *back-and-forth* ***speed*** of light remaining exactly $= c$. It's the radial *coordinate* speed of light that is $< c$. This is the physical principle behind the Shapiro time-delay effect. And it is why a Michelson interferometer mounted on a vertical plane at Earth's surface — to look for light speed anisotropy— would still give a null result, even though the coordinate speed in the radial direction is slower than the coordinate speed in the horizontal direction. The *proper* speed (at least the back and forth proper *average* speed) is the same in all directions.

We can facilitate grasping the difference between proper and coordinate lengths by imagining that the mass of the body on the right side of Figure 9 is being drastically changed from "below." As the mass increases, the proper height increments get more compressed — corresponding to decreased coordinate distances. Yet *all the proper distances remain exactly as they are.* We count 16 rods between the surface and the "top" of the tower. If that distance were actually $= 40,000$ meters, as indicated, then no matter how much mass is added or removed from below, the proper distance to the top of the tower will always $= 40,000$ meters. *The proper distance does not change.*

The key point is that, in the context of Schwarzschild geometry, *a change in mass — and corresponding change in spacetime curvature — does not change* ***proper*** *lengths*, i.e., "actual" lengths. A meter stick is always exactly one meter in length. A change in mass changes the *coordinate* lengths. Whereas, in the context of G-Waves, physicists now speak of the transverse G-Waves — and their manifestation of spacetime curvature — as causing the *proper* lengths of LIGO's arms to change — as though measuring rods would now indicate different numbers of tick marks between the ends. This is nonsense. The new meaning of *proper distance* is not consistent with its meaning in the above discussion. By needlessly scrambling the meaning of words — G-Wavists contradict themselves. Some of the confusing consequences of this word scrambling will be discussed in what follows.

5. More Relativistic Vocabulary

A few more points of terminology that often appear in the G-Wave literature concern, first, the mathematical *coordinate system* used to analyze the situation. Nearly synonymous with *coordinate system* are the terms, *gauge*, or *frame*. Second, are the concepts of *freely-falling*, *geodesic*, and *geodesic deviation*. A freely-falling frame is one that travels on a geodesic path and corresponds physically to a *zero* accelerometer reading. *Geodesic deviation* is the change in distance between two nearby geodesics whose paths may be momentarily parallel, but then diverge or converge due to the non-uniformity of the field. The so-called *transverse–traceless* (TT) gauge (or coordinate system) in particular, is one that treats all components of the LIGO laboratories as freely falling — even as a G-Wave is passing through — which means that all such paths should be expected to yield zero accelerometer readings in horizontal directions, i.e., *transverse* directions, perpendicular to the G-Wave propagation direction, along which G-Waves are presumed to act. The following explanation from the 2020 Oxford PhD Thesis by Patrick M. Duerr should help to clarify:

> The so-called TT-frame is . . . realised by test particles in free-fall. The labels of the coordinates adapted to the TT-frame co-move with the test particles, i.e. along geodesics. (That these coordinates are the ones satisfying the TT-gauge condition introduced earlier, follows directly from the geodesic equation.) Hence, for our ring of test particles the TT-frame is distinguished globally: its coordinates are adapted to all particles in free-fall frames. In the TT frame, no particle in the above scenario changes its coordinate position . . . The G-Wave doesn't affect the particles' kinetic energy. [21]

Duerr refers to the commonly encountered circular "ring of test particles." (See Figure 11.) The ring wobbles in a perpendicular pattern of stretches and squeezes. But the particles that delineate the wobbling ellipse *feel* nothing. They are on geodesic (zero accelerometer reading) paths. In the sequel, Duerr mentions, but does not resolve, the contradiction this description leads to with respect to the *sticky bead argument* (among other matters) that we will return to later. Presently, let's consider these ideas in connection with a common statement found in a book about G-Waves, endorsed by England's *Astronomer Royale*, Martin Rees. In *Ripples in Spacetime*, Govert Schilling writes:

> A passing gravitational wave stretches and squeezes empty space and everything in it. A block of concrete [or the 4 km arms of an interferometer] will actually grow and shrink a tiny little bit in response to the passing gravitational waves . . . Using a ruler [to measure the changes] wouldn't work because the ruler, too, would grow and shrink. [22]

So if two rulers are arrayed perpendicularly across the ring of test particles, corresponding to the stretch and squeeze axes, all points across the whole system *feel* no motion. Measured across every axis, the diameter of the ellipse is always the same. It is always ***measured*** as exhibiting a stress-free circular shape. With respect to an *imaginary, unphysical* static Minkowski background (coordinate scale), the stretching and squeezing can be *calculated and visualized*. But since the ruler spanning the ends of the concrete block, the ring of particles and the interferometer arm all stretch and squeeze in the same proportion, along with *every other physical thing* (including light waves) it means that the speed of light signals between any two points always $= c$ and that the time interval for any back-and-forth light path is also constant: $t = 2L/c$. It follows that there is no way to measure the alleged effect of a G-Wave. It can only be abstractly drawn or *calculated*.

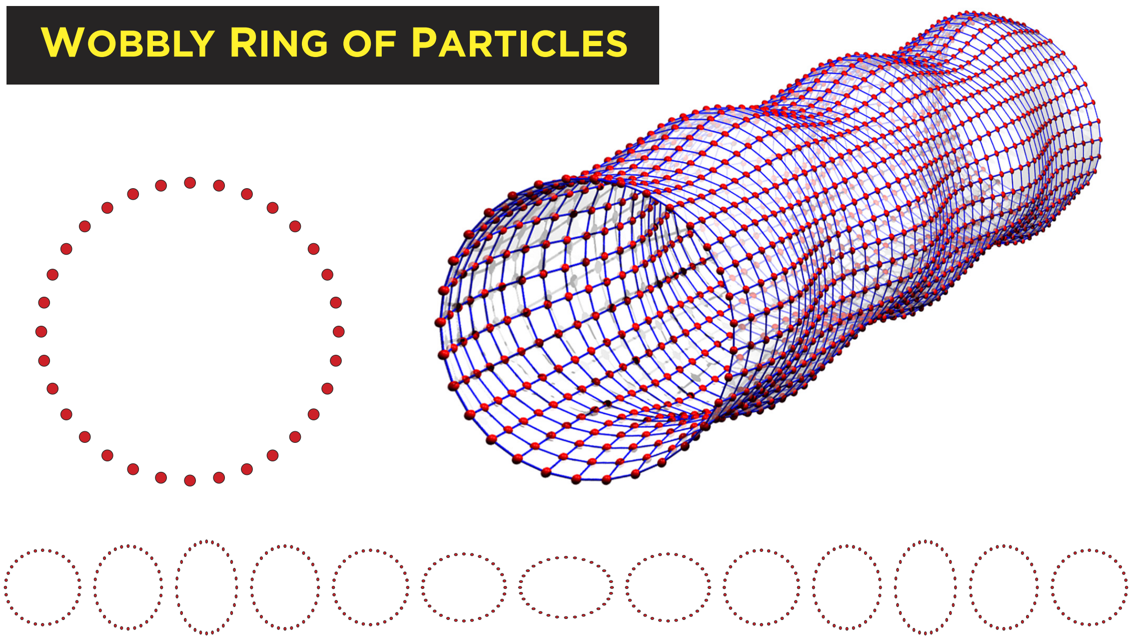


Fig. 11. **Ring of Particles Wobbling Through Time:** A more informative graphic would depict a whole planar array of particles and rubbery rulers that all stretch and squeeze in the same rubbery proportion. LIGOists settle for a circular circumference. Populating the whole plane would more robustly show that the distance across every diameter and between any two points remains ***measurably*** the same. As stated by Saulson and many others, the wavelengths in a laser beam would also stretch and squeeze in the same proportion. Which means that the time required to bounce back and forth across any diameter L also remains the same. It is always $t = 2L/c$. Whether a mere circular ring or a planar array of particles, the stretching effect can be calculated and visualized, but not measured. The Rubber Ruler Puzzle is a no-brainer; not puzzling at all. [23]

LIGOists' contrary claim that the effects of G-Waves *can* be measured is not due to any superceding physical logic. It is entirely due to sociological and psychological factors. Many examples will follow. Having the above discussion in mind, we are now equipped to comprehend the strategy by which the status quo tries to defend itself, as in a long quote from Callister, appearing in his *PhD Thesis* with reference to his Figure 2.1 (our Figure 8). Note that Callister's purpose is to convince his readers that, while a G-Wave is traversing a LIGO interferometer, laser beams will suffer arrival times that *differ* from $t = 2L/c$. Our main point is that his narrative fails to deliver, as becomes poignantly obvious insofar as he never provides a drawing to illustrate how the apparatus supposedly works, and by his transferring the admitted "confusion" to other authors who, as we'll see later, only pile more mudfog onto the picture.

Callister begins:

> Gravitational waves are vacuum solutions to Einstein's equations. In an otherwise flat spacetime, gravitational waves manifest as wavelike perturbations . . . to the ordinary Minkowski metric.
>
> The physical effect of a gravitational wave is to vary the proper distance between freely-falling objects. Consider an enterprising physics student who wishes to measure the distance between herself (at the origin of her coordinate system) and a mirror at position $x = L_\circ$. She decides to do so via the time–of–flight measurement sketched in Fig. 2.1 [our Figure 8], shooting a pulse of

light towards the mirror at time $t = 0$ (event A), letting the pulse bounce off the mirror (event B), and finally recording the time $t_\circ = 2L_\circ/c$ at which the pulse returns to her (event C).

The student decides to repeat her experiment again, but this time in the presence of a passing gravitational wave moving along her z–axis, into the plane of Fig. 2.1. Assume this gravitational wave has a period much longer than the light's travel time to and from the mirror, so that [the G-Wave strain, h_+] is approximately constant for the duration of the experiment. The round-trip time t measured in the presence of this gravitational wave [is] $\Delta t = (2L_\circ/c)\sqrt{1+h_+}$.

The proper distance between the student and her mirror has increased by $\delta L = (1/2)(h_+ L_\circ)$! This is the origin of the term "gravitational-wave strain." Just like a mechanical strain exerted on a material, gravitational waves stretch and shrink the proper distance between freely-falling objects by an amount proportional to the objects' initial separation.

In transverse-traceless coordinates, the effects of gravitational waves are confined entirely to the metric. Initially stationary, freely-falling objects (i.e. the student and her mirror) remain motionless at their initial coordinates, while the space between them expands and contracts to yield the additional time delay Δt. An alternative way to describe gravitational waves involves treating them like a mechanical force. To do this, we adopt local Lorentz coordinates. In these coordinates . . . the metric is fixed by design, and it is instead the mirror that moves in response to incident gravitational waves. To see this, we can return to the above example and compute the geodesic deviation of the mirror relative to our student . . . [Assuming the validity of these coordinates] when applied in the rest frame of our student, [the corresponding] equation tells us that she measures the mirror's acceleration . . . In these coordinates, gravitational waves serve to accelerate the mirror. [Even though accelerometers oriented in the direction of alleged acceleration give zero readings.]

These different coordinate-dependent descriptions — a fluctuating metric vs. an effective force on a fixed background — can be the source of much confusion, offering seemingly contradictory descriptions of how gravitational waves interact with laboratory experiments. When in doubt, it's generally best to revert to thinking in terms of time–of–flight measurements. [69, 70] [24]

Now we need to gather and consolidate this deluge of terms and ideas, to point out contradictions and to build on what is sound or salvageable. Obviously this cannot be done all at once. Some of the pieces will fall into place later. For example, we will later follow through with Callister's final references [69 and 70] — two papers by Peter Saulson. Some facts that we'll address in more detail later we will briefly go into momentarily for their present pertinence and as a preview of what's to come. For example, the concepts of *proper length* and *geodesic deviation* are immediately applicable to the famous *sticky bead argument*, and discussions motivated thereby.

Callister says that "the physical effect of a gravitational wave is to vary the proper distance between freely falling objects," even though "the student and her mirror remain motionless at their initial coordinates." Already we have a contradiction. A change in proper distance *means* that the number of tick marks will have changed. But there is no change in the number of tick marks. The expansion and contraction Callister speaks of is not physical but merely *calculable*. It requires invocation of the imaginary "Minkowski metric." We can *mentally* conceive that the number of Minkowski metric tick marks changes, but this cannot be *physically* measured because all physically available measuring rods wobble in the same proportion. ***Measuring the wobble requires an unwobbled measuring device. Such a thing does not exist. This is the crux of the Rubber Ruler Puzzle***—the briar patch of a dilemma that Callister and other G-Wavist always try to, but never succeed in talking their way out of.

In this case, Callister refers to the common *geodesic deviation* maneuver, but fails to explain, much less *depict* how that helps. He tries tippy-toeing around the confusion that he sheepishly seems to acknowledge having stirred up. Callister's intent is to clarify, but when the muddle gets too thick he hands-off to Peter Saulson, and to the "time–of–flight measurements," even as these alleged "measurements" are not measurements at all. The word *measurements* should read: ***presumptions,*** time-of-flight *presumptions*. They do not follow from a sensible analysis of the facts. They are mental phantoms.

Not wanting to get too far ahead of ourselves, let's linger to consider what *geodesic deviation* means outside the context of G-Waves, to see if it makes in the context of G-Waves. (See Figure 12.) Geodesic deviation means the "relative acceleration of two neighboring geodesics." [25] The cited *Wikipedia* article explains:

> In general relativity, if two objects are set in motion along two initially parallel trajectories, the presence of a tidal gravitational field will cause the trajectories to bend toward or away from each other, producing a relative acceleration between the objects. [25]

The key thing about this description is that it allows the physical possibility of adjacent objects, other nearby objects — not necessarily on geodesics — to exist and to be used to actually measure

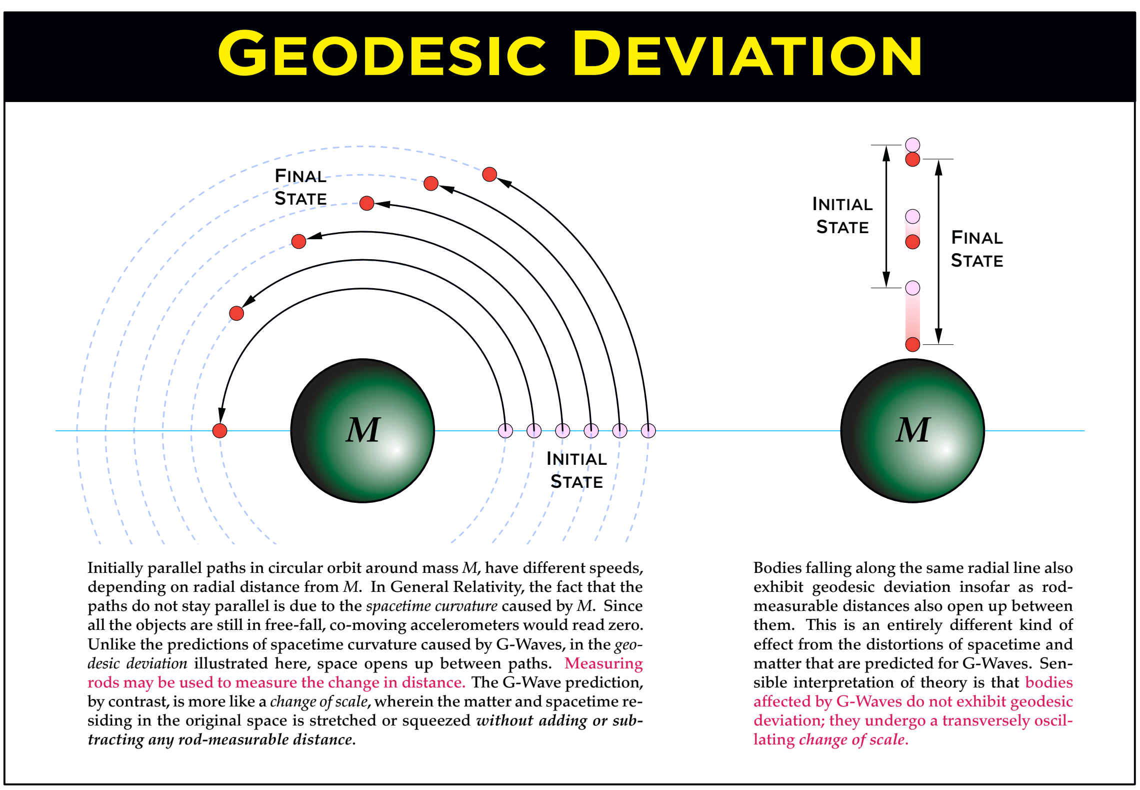


Fig. 12. **Geodesic Deviation in Real World Gravitational Phenomena :** Completely unlike claims made in the convoluted context of G-Waves.

the geodesic deviation of the original objects. (This is real world physics.) In other words, by virtue of the diverging or converging motion of two geodesics, the space between them *visibly* opens or closes (the distance increases or decreases, respectively) so as to allow (in the case of opening) other objects to occupy that space, and to physically measure the change. Because this case involves two free objects in motion with respect to each other, the proper distance between them does indeed change. The change is physically measurable with light waves or measuring rods, by nearby or far-away observers.

LIGOists often refer to the G-Wave effect on a material "stick" or the material tubes of LIGO as the constituent points undergoing geodesic motion and applying the geodesic deviation equation to them. But in these cases, the real world fact of actually opening up spatial distance is contradicted. It doesn't make sense. The G-Wave effect on distances between the extremities of a stick or LIGO's arms is more like a *change of scale*. Recall Schilling: "Using a ruler [to measure the changes] wouldn't work because the ruler, too, would grow and shrink." This is entirely unlike the real world cases depicted in Figure 12 in which the motion may be characterized by the increasing or decreasing number of rod-measurable tick marks between the objects.

To my knowledge no G-Wavist has ever explicitly claimed that, treated as tick-marked rulers—or as *measured* by any adjacent physical ruler—LIGO's arms would lose or gain tick marks because of the passage of a G-Wave. This is what must happen for the *proper distance* to change; for there to be any real *geodesic deviation*. In light of this clarification, Callister's claim that "the student and her mirror remain motionless at their initial coordinates, while the space between them expands and contracts to yield the additional time delay Δt" is utter nonsense. To "yield an additional time delay" requires the extremities to move *measurably* away from each other. But the imagined motion is *not* measurable. No *physical* scale exists by which such motion can be observed. The effect is *mental*—***calculable, but not physically measurable.***

The extreme smallness of the predicted effect may appear as an excuse to not think of the lengths of LIGO's arms in terms of tick marks. But *it's no excuse*. It is in fact nearly always *advisable* to consider the most extreme case—to scale up the physical phenomenon to the maximum—to more clearly reveal the principles involved. Every point of a scale-changed LIGO arm maintains an *unchanging proper distance* from every other point because any G-Wave-caused motion that may "really" be taking place affects matter, space and light in the same proportion, therefore rendering it *unmeasurable*. Motion (and changing time delays) can be *imagined as calculable* things, with respect to an imaginary frozen (Minkowski) scale—but *NOT as anything physically measurable*. Claims to the contrary are either delusional or deceitful, or both.

6. Mindset and Schizoid Communication Style of LIGOism

If the proper length increases, then the number of tick marks between extremities must also increase. Or else *proper length* no longer means what it used to mean, and someone is just playing word games, not doing physics. Consistency with the definitions of *proper length* and *geodesic deviation* means that, if the original tick marks on LIGO's arms are each envisioned as *properly, geodesically* moving with respect to one another on their own particular geodesics, then their separations must measurably change; the *proper* separation between extremities and any marked points in between must measurably change. Which means, again, that some other ruler—a ruler that is not affected by the G-Wave—must be invoked to measure the movement of the ruler (LIGO arm) that presumably *is* affected by the G-Wave. If this is not what LIGOists envision when they invoke "geodesic deviation" then geodesic deviation no longer means what it used to mean and someone is just playing word games, not doing physics. In any case, it makes no sense. There is no unwobbled ruler. That ruler with respect to which the number of tick marks changes is not physically possible; it is only in their heads.

LIGOists want to have and to eat the same cake. They want to keep the scale change picture in one side of their brain and pretend that it can logically co-exist with the changing number of tick marks picture on the other side of their brain. In reality, the pictures are mutually inconsistent. Why was this not perceived long before the monumental LIGO boondoggle was bankrolled? As we will later see, John A. Wheeler and Richard Feynman are among those who perpetuated this sloppy thinking. Perhaps even more so, those many disciples inclined to *believe* them.

It is enlightening to expose a few more examples of G-Wavists trying to have and to eat the same cake. LIGOists commonly describe the arms of their apparatus as being *stretched and squeezed* by G-Waves. In 2004 LIGOist Peter Shawhan, for example, explained that: **"Any object encountered by a gravitational wave is stretched and shrunk along with the space in which it lives."** [26] Although this description echoes Schilling's, Saulson's, and many others, we sadly find that Shawhan tries to waffle his way out of its robustly clear meaning. Figure 13 is a copy of the *American Scientist* Letters section in which an intelligent reader interprets Shawhan's statement exactly as we have. Shawhan's published response is a *tour de force* of gaslighting mudfog. Such is the mindset and the communication style of a community that, 11 years later, would stick to their guns by announcing the detection of G-Waves, perpetuating one of the biggest hoaxes in human history. Because LIGO's cultural roots are so deep, because their façade of legitimacy is so polished and well-funded, our critique requires overkill. Repetitious though our argument may be, it is important to perceive the contradictory manner of the status quo in its many instances and variants. Over-exposing the corruption and sloppy thinking is no cause for apology. Instead we resolutely press on.

Next we note that Nobel Laureate Kip Thorne has likened the effect of a passing G-Wave to the oscillatory deformation of a "rubber membrane." Many LIGO-sanctioned graphics and video animations give this impression. Saulson is more specific than most for claiming that both the *light* within and the *material arms* themselves are both subject to deformation "by the same factor." This may be called the *multiplicative* description, which is patently *continuous*, as a transverse oscillatory *change of scale*. As we've just discovered, however, it is quite unlike oscillating changes in *proper distance* or *geodesic deviation*.

The closest thing to a justification for G-Wavists' contradictory scheme depends on their at least mathematically thinkable Minkowski background — and treating it as a physically real thing. This is implicitly done to establish a *discontinuous* break from the continuous rubbery scale change, which they typically do not deny also happens. The imaginary Minkowski grid is from where they get their increased and decreased numbers of tick marks (which they misguidedly call changing *proper* distances).

Changing lengths with respect to the imagined Minkowski grid may be called the *additive* (and arguably ill-conceived) description of the effect of G-Waves. Alleged changes in proper lengths and geodesic deviation are invoked to yield a magical tally of more or fewer tick marks *computed* with respect to a dead flat phantom (Minkowski space). If the idea is expressed as a spacetime diagram it is immediately seen as absurd (as Andersen's attempt, Figure 5). Geodesic deviation is a particular kind of change of proper length, as illustrated in Figure 12. Since Minkowski space is an imaginary phantom, changes in proper lengths and geodesic deviation in the context of G-Wave "physics," are delusional hand-waving hogwash. The *additive* description of the effect of G-Waves is utter nonsense.

By contrast, the scale change mode of description is *comprehensive*. If G-Waves exist at all, then *everything* is affected continuously. "**Any object** encountered by a gravitational wave is stretched and shrunk along with the space in which it lives." That's it. This is the message Shawhan ought to

American Scientist

Physics

This article from issue November-December 2004 Volume 92, Number DOI: 6 10.1511/2004.50.0

Wavy Gravy

To the Editors:

I had hoped that Peter S. Shawhan's article "Gravitational Waves and the Effort to Detect Them" (July-August), would have cleared up a question about light waves. Shawhan states **"Any object encountered by a gravity wave is stretched and shrunk along with the space in which it lives..."** Does this distortion include the **wavelength of any light** propagating in that space?

The interferometric comparison of the relative lengths of the arms of a gravity wave detector essentially measures the number of wavelengths of laser light contained within each arm. If the arm length is changed by the incidence of a gravity wave, and the light wave moving parallel to the arm is changed by the same amount, then **the number of wavelengths in each arm will be unchanged, so there will be no interferometric evidence of the gravity wave.**

I can't see any way that the interferometric detectors can work if the light wave is also stretched.

Sylvan Rubin
Los Altos, California

Dr. Shawhan responds:

The wavelength of light is not a physical length, but a measure of the distance over which its electric and magnetic fields complete one cycle of oscillation. In relativity theory, length and distance are effectively defined in terms of the time required for light to travel from one point to another.

When a gravitational wave stretches the effective length of one arm of an interferometer, the laser light takes a slightly longer time to travel from the beam splitter to the end mirror and back to beam splitter, so the phase of the light evolves through an extra fraction of a cycle. That is, the arm contains a slightly greater number of wavelengths of laser light.

An Astute Reader's Perception of the Failure, in Shawhan's Original Article, to Address (much less solve) the Perennial *Rubber Ruler Puzzle*

Shawhan's response is dishonest and inadequate, as indicated by the color-coded annotations below.

Lie.

The opening lie is immediately contradicted. Not only is a laser beam's wavelength a physical "measure of distance," wavelengths are routinely measured in optics laboratories every day. So why lie?

The most physically logical picture corresponding to this definition—consistent with the statement quoted by Rubin—is one showing that the matter and the light ("any object") stretch in the same proportion (as in our Figure 3 and the Top of Figure 4). Why does Shawhan not simply draw his own picture to demonstrate the consistency of his definition? Is it because doing so makes it obvious that Rubin's closing complaint rings true? Since "any object encountered by a G-Wave is stretched...along with the space in which it lives," the light-travel time to bounce back and forth through that space will always be the same, G-Wave or not. Interferometers cannot detect G-Waves.

"Laser light takes a slightly longer time..." because we say so, or because of an actual physical reason? This is a classic hand-waving "explanation." Gaslight PhDizzix. Nothing physical about it.

When Shawhan and his colleagues say everything gets stretched and shrunk by G-Waves, their brains are in physical scale-change mode (everything wobbles). When they say they get "an extra fraction of a cycle" (i.e., tick mark) their brains are in Magical Static Minkowski-land. They jump back and forth from a physical mode of thinking to a fantasyland of hand-waving magic, if not because they are themselves confused, then to keep everyone guessing. And the NSF funds keep rolling in. Nevermind the contradiction: Periodic scale change is possible (however unlikely). But having tick marks appear, presto-chango out of nowhere contradicts the stretching and squeezing picture because the tick marks—both the originals and the extras (wavelengths)—are exempt from the deformation. That's their magic. That's why you must not ask for a diagram. You must not even think about it. Amen.

Fig. 13. **Sylvan Rubin Calls the Bluff:** Or is it a self-delusion? Either way, Shawhan's response is cringeworthy.

have defended and amplified. He should have conceded as much and more to his critic, Sylvan Rubin. The scale-change description cogently covers both light and matter. There is no discontinuity. There is no *physical* manifestation of the imaginary Minkowski background. So it is not possible to physically detect a G-Wave.

Though often presented alongside each other, like oil and water, the multiplicative scale change perspective and the additive tick mark perspective do not mix. The spacetime analog of a vibrating "rubber membrane," admits neither the insertion nor the extraction of tick marks to change the proper size of anything residing therein — neither matter nor light waves, nor the *speed* at which light travels. LIGOists resist this conclusion because it is contrary to scripture, in which they have invested their souls. Shawhan's response to Sylvan Rubin is like that of a fearful, deviously corrupt priest to a young, bright, inquisitive member of his flock.

7. The Muddle of G-Wavism

7˙1. *Sticky Bead Nonsense, Take 1*

LIGOists scramble the *multiplicative* (scale changing) and *additive* (Minkowski tick mark) modes of description such that they coexist in the G-Wave literature in a morass of confusion and inconsistency. Being interested in the fundamental truth of the matter, Rotonians recommend casting a wide net over the affair — to develop a sense of which elements of the schtick are being employed in any given context. The most common G-Wavist strategy is to leave all this controversial confusion out of the discussion. To just *assume* that theorists — especially theorists of greater stature than one's own — know what they are doing, to *assume* not only that G-Waves are findable, but that they've already found a whole bunch of them. That's the company line, which deserves, as argued here, our vehement objection.

We are rightly suspicious when G-Wavists claim that the *proper* lengths of LIGO's arms change due to passing G-Waves. They say this very often because they *must* have — *they absolutely must have* — that the time-of-flight of laser beams changes, oscillating from arm to arm, not so much as a stretch/squeeze/stretch/squeeze of a rubbery ruler or membrane, but as an addition-of-tick-marks/subtraction-of-tick-marks/addition/subtraction, etc.

At a famous meeting in 1957 Richard Feynman and others proposed that G-Waves should be measurable based on the *assumed*, easily visualized effect on two beads that are loosely resting on a smooth rigid stick. As we contemplate this proposal, bear in mind the close similarity to one of LIGO's arms and our above discussion concerning the difference between a scale-changing kind of motion and a number-of-tick-mark-changing kind of motion. Since Feynman argued explicitly that a G-Wave would cause the beads to move with respect to the unmoved stick (as seen in Figure 14) this is obviously a number-of-tick-mark-changing kind of argument.

We can easily imagine that tick marks are drawn on the stick, as in Figure 15. If in the absence of a G-Wave the beads are separated by a distance of $L = 10.0$, say, then the G-Wave could cause an oscillatory motion *out* to a separation distance of $(5/4)L = 12.5$ say, and then *in* to a separation $(4/5)L = 8.0$ (as in the Figure). Feynman claims that the stick is essentially rigid, so that its tick marks correspond to a flat, rigid, Minkowski grid. If light rays were bounced between the moving beads, their back-and-forth times-of-flight would oscillate in proportion to the same length differences stated above.

The main problem with this idea is that the atomic forces "trying" to hold the stick rigidly together are many orders of magnitude too small to do the job. The rigidity of spacetime, as deduced from theory and as predicted to be manifest by G-Waves, makes the interatomic forces

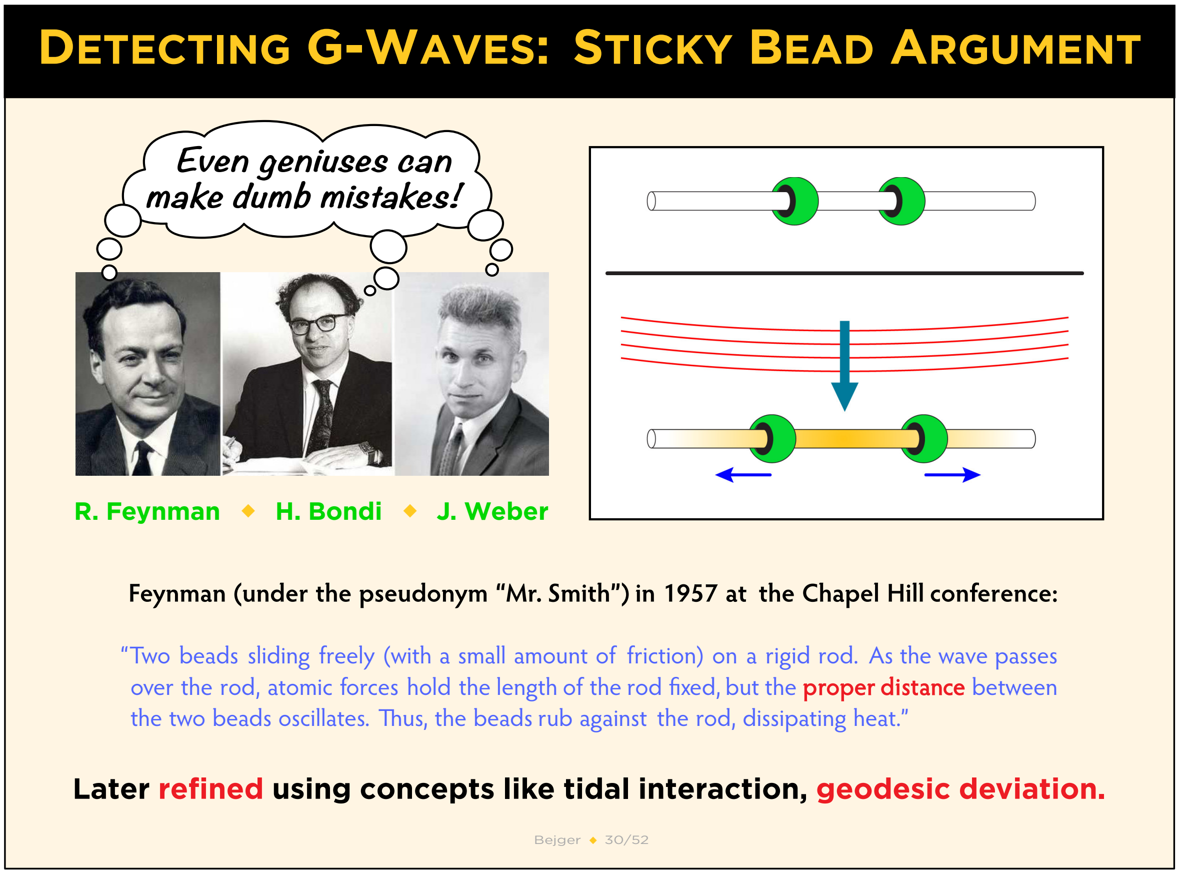


Fig. 14. **The Dopey Stick and Bead Argument in Bejger's Presentation Slide:** As against the many orders of magnitude greater stiffness of spacetime and its alleged G-Waves, the resistance put up by interteratomic stick forces is "utterly negligible." So the stick would be effectively just as wobbly as the rest of space. It would stretch and squeeze in the same proportion as the bead separation distance. Also, official LIGO marketing materials ubiquitously show LIGO's arms — and even the whole Earth — getting stretched and squeezed by G-Waves. The plethora of excuses about the confusion caused by conflicting "coordinate-dependent descriptions" adds neither clarity nor "refinement." It provides the cover of chaos. [Thought bubble added.] [27]

"utterly negligible" by comparison. This is often stated, but only rarely used as a foil to dispose of Feynman's silly idea — even though this is the obvious conclusion: The sticky bead argument makes no sense. To point this out is to defy and embarrass the holy ghost of Feynman and everyone who believes in him. "Loyal" physicists dare not tarnish the idol. It's a pathetic scene.

The idea that the presumed motion of the beads can be thought of as being due to a kind of *tidal force* or *geodesic deviation* makes no sense either, because — as discussed above — geodesic deviation (and tidal force) allow the juxtaposition of adjacent rigid objects (e.g., tick-marked rulers) that can be used to *measure* the effect. Whereas in the case of G-Waves, no physical thing is rigid enough to serve this purpose. Stretching or squeezing of the *whole* scale — the *whole continuous scale* — as often depicted in official LIGO media, means that proper distances are not changing from the original length (no increased or decreased numbers of tick marks). So it makes no sense to suppose laser

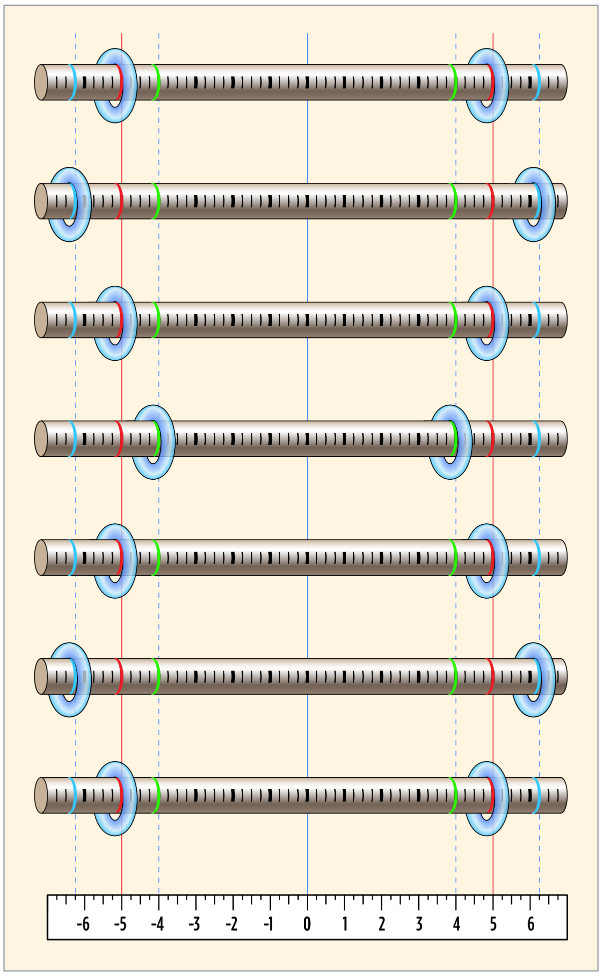


Fig. 15. **Stick with Tick Marks and Oscillating Beads:** Feynman argued that the interatomic forces holding the stick together allow only negligible stretching and squeezing of any tick marks laid out on the stick due to an impinging G-Wave. Whereas the tick mark-measured distance between beads loosely placed on the stick is supposed to increase and decrease because of such a wave. The often reported fact that *space is predicted to be many orders of magnitude stiffer than steel or diamond* contradicts Feynman's conclusions based on this ill-conceived thought experiment. [27]

beams take increased or decreased times to bounce back and forth between the three fixed points of LIGO (beam splitter and two end-mirrors).

In LIGO's ongoing propaganda/marketing project the meanings of relativistic terms and ideas have thus morphed to accommodate the *belief* in the measurability of G-Waves. *Proper length* and *geodesic deviation* have been invoked to support their idea, but only inconsistently, because these terms no longer mean what they originally meant. The word-games, incompatible graphics and contradictory descriptions of G-Waves in the literature have resulted in a conceptual jumble of incoherent ideas — to quote Feynman (**Part 2**, p. 3) a chaotic "***tyranny*** of ideas." Ironically, this serves the mission of LIGOists quite well. Chaos and tyranny are effective camouflage for ignorance and deception.

7˙2. *Misner, Thorne and Wheeler: Physics or Flim-Flam Flummery?*

> *I know that the family members who know me better than I know myself say I'm a plunger. I think my grandfather was a plunger, my grandfather Archibald . . . And my father, too.*
>
> John Archibald Wheeler : Famous Physicist : (1994) [28]

The elder of the trio, John Archibald Wheeler, named in our section title, was born in 1911 and died in 2008. His influence in modern theoretical physics is ubiquitous. The biographically oriented interview (conducted by one of Wheeler's ex-students, Kenneth Ford) in which our opening quote was found, reveals a rich and fascinating life. Wheeler was definitely a character, a sometimes likable, entertaining, and perhaps even insightful character.

Hints of a darker side may also be suspected, however, as in Wheeler's admitting that his family thought of him as a ***plunger***. The sense of the word in this context is that of a "dashing or venturesome gambler or speculator." [29] This characteristic emerges in the physics of Wheeler, as will be seen later. First, however, we need to divulge an even more worrisome indicator, as revealed by an inexcusably devious act committed by Wheeler in the name of science.

In 1985 Wheeler responded to a letter from me, wherein I pointed out the lack of empirical evidence to support a claim made in his famous book *Gravitation*. [30] Wheeler invented patently false evidence and presented it to me as the truth. Wheeler lied to me in the name of science. Whatever compunction I may have about "speaking ill of the dead," and however embarrassing the incident certainly is, these reservations are superceded by the need for the truth, by the need to get an *accurate* picture of the sociology of physics instead of papering over its boils and tumors. This is especially true because the thing Wheeler lied about is the very experiment Galileo proposed in 1632, which has not yet been done. Wheeler has acted not as an advocate, but as an *obstructor* of physical truth. If the airing of some dirty laundry is needed to reduce the arrogance and corruption in academic physics, then so be it. I do not apologize.

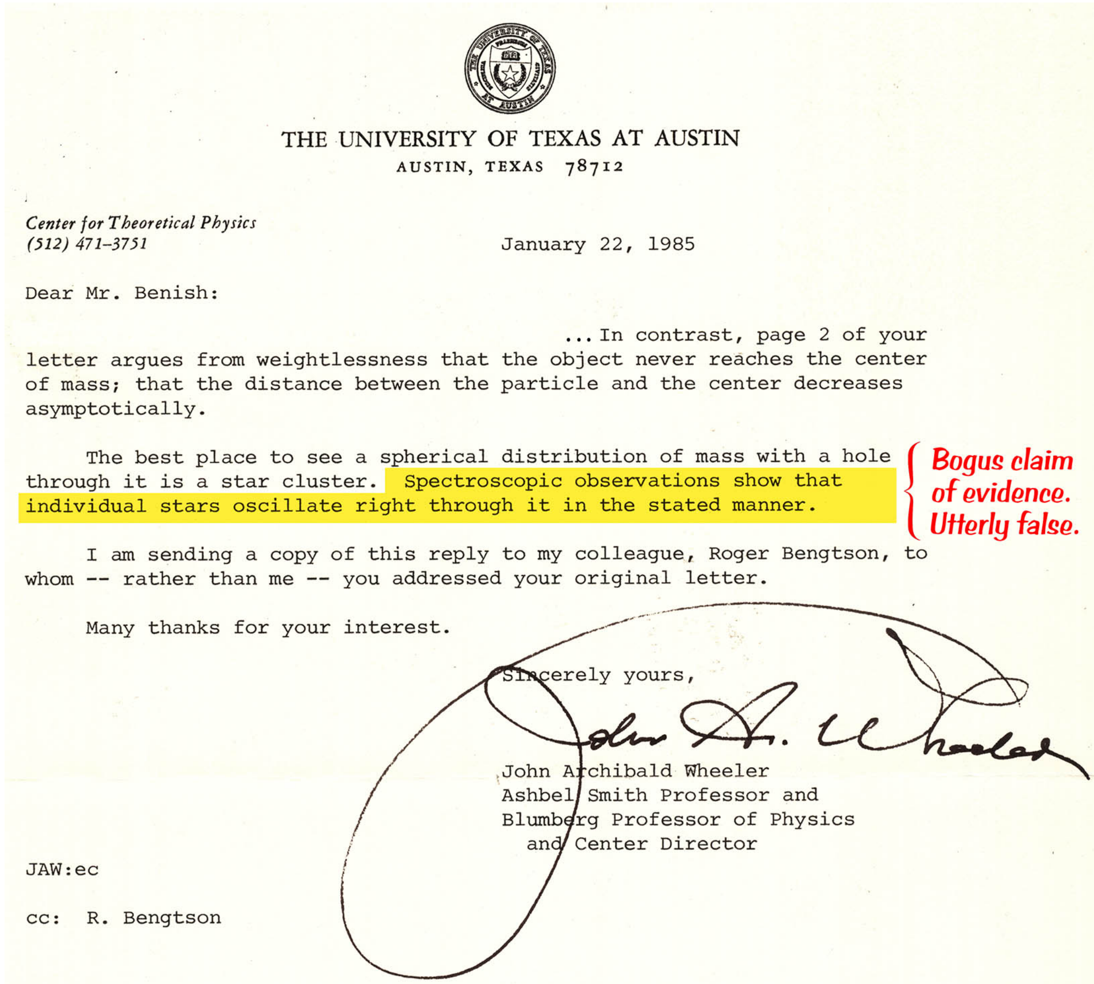
The pertinent parts of Wheeler's response letter are copied in Figure 16. We see that Wheeler resorts to falsity in defense of statements made in his book *Gravitation* (from p. 39):

> Test particles A and B move up and down a hole bored through the Earth, idealized as of uniform density. At radius r, a particle feels Newtonian acceleration . . . Consequently, each particle oscillates in simple harmonic motion with precisely the same angular frequency as a satellite, grazing the model Earth, traverses its circular orbit. [30]

In response to my letter, Wheeler wrote:

> The best place to see a spherical distribution of mass with a hole through it is a star cluster. Spectroscopic observations show that individual stars oscillate right through it in the stated manner. [31]

The first suspicious fact about Wheeler's response is that he provided no references to support his claims. Upon visiting the Astronomy Library at UC Berkeley, looking for evidence, my search yielded the fact that stellar oscillations through the centers of star clusters — if they happen at all — would take thousands of years. Wheeler has been shown that this happens? Is he a god? Then there are the observational problems of telescope resolution and spatial location uncertainty.



THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

Center for Theoretical Physics
(512) 471–3751

January 22, 1985

Dear Mr. Benish:

...In contrast, page 2 of your letter argues from weightlessness that the object never reaches the center of mass; that the distance between the particle and the center decreases asymptotically.

The best place to see a spherical distribution of mass with a hole through it is a star cluster. Spectroscopic observations show that individual stars oscillate right through it in the stated manner.

I am sending a copy of this reply to my colleague, Roger Bengtson, to whom -- rather than me -- you addressed your original letter.

Many thanks for your interest.

Sincerely yours,

John Archibald Wheeler
Ashbel Smith Professor and
Blumberg Professor of Physics
and Center Director

JAW:ec

cc: R. Bengtson

Fig. 16. **In the Name of Science, Wheeler Lies to Benish:** Contrary to the implication of the penultimate paragraph, I did send a letter to Wheeler — the same as the one sent to Dr. Roger Bengston, whose office was down the hall. Wheeler's stack of mail was no doubt too large for him to notice my letter. In this case the down the hall strategy worked. Proof that Wheeler lied, in case it's not obvious, is contained in an email from astronomer Kyle Cudworth (Figure 17). [31]

Some of these problems are mentioned or alluded to in the response I got from astronomer Kyle Cudworth, eleven years after Wheeler's response (Figure 17). [32] The most charitable assessment would be to say that Wheeler was eager to dispose of the criticism in an annoying letter from an amateur, so he invented "alternative facts" to brush me away.

The key questions for not only Wheeler, but the whole rest of the physics community are:

> Why not admit that the standard oscillation prediction is just an unverified *guess*? Why not, therefore, encourage the idea to build and operate humanity's first *Small Low-Energy Non-Collider*?

Kyle Cudworth, 7/8/96 8:45 AM -0700, Re: gravity-induced radial oscillation

Date: Mon, 8 Jul 1996 10:45:28 -0500
From: Kyle Cudworth <kmc@hale.yerkes.uchicago.edu>
To: rjbenish@teleport.com
Subject: Re: gravity-induced radial oscillation

I am quite sure that Hubble observations have not directly shown stellar oscillations through the centers of star clusters. Hubble has observed the centers of clusters (and of galaxies) but the observations have been of only one component of the stellar velocities, with the other two components left unmeasured. The interpretations of the data make assumptions about the other components and then make general statements that may sound as if everything is known, but that's very different from the kind of clear observational demonstration you (and I) would want. In fact, there isn't even very much one-component velocity data on individual stars near the centers of clusters from Hubble. I was part of a team proposing to do more such work last year but our proposal was turned down because of the enormous amount of telescope time it would require to get useful data. We are optimistic that a new instrument to be installed on Hubble next year will make this project less time-consuming and we are starting now to prepare a new proposal to try again. That will, however, still be only one velocity component - but better one than none is our attitude.

Kyle Cudworth

Astronomer whose career often specialized in the motions of stars within star clusters.

Printed for Richard J Benish <rjbenish@comcast.net> 1

Fig. 17. **The Truth about Stellar Motion within Clusters:** Having specialized in studying the motion of stars in clusters (especially "proper" motions, i.e., the change in position across the sky) for much of his career, Kyle Cudworth honestly explains the state of the art. [32]

Wheeler's pretending to know things he doesn't really know, his failure to come clean, and the way he condescendingly tries to pass his bullshit off as physical facts is worse than embarrassing. It's an egregious sin of science.

Matters were made worse a few years later (1990) when *Scientific American* published a slick book by Wheeler, intended for general readers: *A Journey into Gravity and Spacetime*. [33] The book includes a 10-page chapter blindly devoted to the *guess* that, with respect to a "spherical distribution of mass," test objects "oscillate right through it in the state manner." Being ever mindful of marketing gimmicks, Wheeler invokes a new word for this alleged phenomenon: *Boomeranging*. Nowhere in these 10 pages of fantasy do we find even a hint that empirical confirmation of the prediction might be wanted or needed.

Kenneth Ford's interview, quoted above, was one of a series made available by the American Institute of Physics, all of which served as source materials for the co-written autobiography: *Geons, Black Holes and Quantum Foam.* [34] In the interview Ford inquired as to Wheeler's "very special flair . . . his use of language . . . diagrams . . . coinage and enthusiasm." In his reply, Wheeler traced these things back to the sign painting experience of his father, who strived to maximize the "impact of a sign, to make it really hit."

Wheeler seemed to take pride in citing his own paper wherein he proposed the importance of "Planck Units"—*Planck Length*, *Planck Time*, *Planck Temperature*, etc. Wheeler relates this idea to his "Quantum Foam," approach to quantizing gravity. As seen on the **Cosmic Everything Chart** (**Part 2**, Figure 12, p. 32) however, the Planck Scale is an utterly useless concoction. Like Wheeler's "Geons," and "Wormholes," it may have entertainment value, a kind of television Sci-Fi appeal, but it has nothing to do with the actual physical Universe. Packaged with fantastic enough "flair," however, even useless inconsequentialities can be sold for big bucks by the carnival maestro (and plunger) John A. Wheeler.

Wheeler delighted in selling his interpretations of existing theory by "finding slogans to describe the key features of the subject." Wheeler specifies as a prime example the popular cliché he invented: "Space tells mass how to move, and mass tells space how to curve." Neither Wheeler nor any of his "entourage" (as Thorne, *et al* have called Wheeler's loyal followers [35]) have bothered to ask the obviously more important questions: *What is hiding behind the word **tells**? How exactly are the orders carried out? What exactly does matter **DO** to make spacetime curve?* Satisfied with shallow, yet sloganable fluff, Wheeler and Co. seem to bask in the spotlight, as they carry out their act with nauseating smugness.

Wheeler was a staunch advocate for not only the existence, but the *measurability* of G-Waves. He was among those in attendance at the famous 1957 Chapel Hill Meeting, along with Richard Feynman and Joe Weber. Not only did Wheeler not object to the obvious flaw in Feynman's sticky bead argument, he encouraged Weber's endeavors to build his ill-fated bar detectors. Having seen the result of Weber's misguided enthusiasm, years later Wheeler confesses to "have another guilt feeling from that time, that I gave such a feeling of reality to gravitational waves that Joe Weber has devoted himself since then to trying to detect gravitational waves, and taking what I think are instrumental effects as indicating real waves."

Given the present state of gravitational physics on Planet Earth, Rotonians lament the flair-laden, slogan-rich, evidence-poor influence of John A. Wheeler, the showman and prevaricator. Kip Thorne, Joe Weber and Richard Feynman were all his protégés, each with his own degree of flashiness, questionable connection to reality, and sometimes with their own batch of graduate student protégés, who tend to perpetuate the tradition.

Ironically, Daniel Kennefick, who obtained his physics PhD under Kip Thorne's supervision, came to divulge some disconcerting discoveries about the sociology of physics, at least partly as a result of being invited to give a talk to an audience of G-Wave veterans—by none other than John A. Wheeler. At the prestigious Second Sakharov Meeting in Moscow, in 1996, the green, not-quite-PhD graduate student Kennefick began his talk by stating—based on personal interviews and the published record—that there were some skeptics in 1957 about the existence of gravitational waves. He was "immediately interrupted by [the well-seasoned] Bryce deWitt sitting in the front row." Kennefick paraphrased deWitt: "You weren't there in the 50s . . . There was no one saying then that gravitational waves didn't exist."

After an awkward moment and eventual rescue by other participants in the room, Kennefick finished his lecture without further incident. Kennefick regarded it as worthwhile to include this anecdote in his book *Traveling at the Speed of Thought* because of the light it sheds on the "folk memory" and the sociology of the community. Kennefick reflects:

> Within the historical memory of the field . . . the folk memory is to underemphasize . . . that there was ever much public discussion . . . that many relativists were skeptical of gravitational waves . . . To suggest . . . that there was really a problem in the general sense would be to go too far. There is a preference not to remember or not to overstress the significance of something which may be seen

> as vaguely disreputable to the field. It is a characteristic aspect of physics that to pose a problem or a question may, in itself, be taken as a sign of bad character. [36]

Being a member of the community about which he writes, Kennefick chooses his words carefully. The blunt translation is that the community suffers from its own brand of *corruption*. But Kennefick is so steeped in the lore of the community, so indebted to and respectful of the likes of John Wheeler, Kip Thorne and Richard Feynman, that his criticism will remain understandably mild. Having no such loyalties, Rotonians are inclined to call 'em as they see 'em. And it aint pretty.

In Kip Thorne's 2002 Caltech lecture, for example, he contradicts the claim of Peter Saulson (as quoted at the bottom of Figure 3) that "The arms of an interferometer are lengthened by a gravitational wave. The wavelength of the light in an interferometer is also lengthened by a gravitational wave, by the same factor." Thorne leads up to this contradiction, explaining to his Caltech students:

> Gravitational waves in fact, then, are ripples in the spacetime curvature that propagate through the universe.
>
> I've talked about the effect of a gravitational wave in terms of a stretching and squeezing of inertial frames relative to each other. We can also think of that as a stretching and squeezing of space, like you would have if you stretched and squeezed a rubber membrane. And so a gravitational wave then stretches and squeezes space.
>
> Something that I often get asked: [Does] the wavelength of the light in the gravitational wave get stretched and squeezed in the same manner as the mirrors move back and forth? If that is the case, then obviously you won't be able to see the motion of the mirrors using light. There will be no physical manifestation. But in fact the answer is "No." The spacetime curvature influences the light in a different manner than it influences the mirror separations. Because the light is moving at the highest possible speed relative to the inertial reference frame of these mirrors.
>
> And because of that high speed, it [i.e., the light] feels different pieces of the spacetime curvature than the mirrors feel. And so it is influenced in a different manner. And in fact it turns out that if you adopt the appropriate gauge in general relativity, then there is [sic] and if the mirrors have a separation that's small compared to a wavelength of the gravitational waves then the influence on the light is negligible, and it's only the mirrors that move back and forth. And the light's wavelength doesn't get changed at all, in that limit. [37]

The accounts of Saulson and Thorne clearly contradict each other. They cannot both be right. Light and matter are either stretched and squeezed "by the same factor" or "light is influenced in a different manner" from how matter is influenced. The obvious contradiction has never been resolved. It just festers away in the dumpster of the G-Wave "literature."

What else can we unpack from this incoherent story? If the "stretching and squeezing of space," of "inertial frames" is like "stretching and squeezing a rubber membrane," then how does the *magnitude* of the speed of light in that space cause light to be "influenced in a different manner" than anything else through which a G-Wave travels? *Different* how? Why? Is Thorne just spewing nonsense? Striving to find anything sensible in his remarks, one wonders about his final three words: "in that limit." In what precedes our selection Thorne does not explicitly refer to any "limit." So perhaps he means the "limit" wherein the *matter* of the LIGO arms *does* get stretched and squeezed, "*light* waves *do not* get stretched or squeezed." But this contradicts the membrane analogy because a "stretched inertial frame" is the medium through which light travels. A stretched "inertial" membrane *means* stretched wave lengths.

It also contradicts the sticky bead argument, because the stick is analogous to a LIGO arm. If the stick is prevented from stretching due to interatomic forces, then so is the LIGO arm. Whereas Thorne claims the arm length (distance between mirrors) does get stretched. Does the membrane idea pertain to *matter*, but not to *light*—or to light, but not to matter? *Oiy vay!* Either way it makes no sense.

Perhaps Thorne envisions, in accordance with some "appropriate gauge," something like the lavender wedges in our Figures 3 and 4—showing the light beams arriving early and late, as predicted. But again, this contradicts the idea that "inertial frames in spacetime get stretched and squeezed like a rubber membrane." As shown at the Top of Figure 4, measuring rods immersed in the membrane always give the *same* proper distance between any two points, no matter how the membrane is distorted. To *physically* measure the magnitude of the stretching obviously requires a *physical* ruler that remains unstretched; it requires a perfectly rigid, *NOT IMAGINARY*, utterly static ruler. Such a thing does not exist. Such a thing does not exist. ***Such a thing does not exist.*** So the speed of light and the time to bounce back and forth remains the same, G-Wave or not—which is the most straightforward interpretation of Thorne's own analogy.

Thorne admits that if "the wavelength of the light in the G-Wave gets stretched and squeezed in the same manner as the mirrors move back and forth, then obviously you won't be able to see the motion of the mirrors using light." Claiming that "the spacetime curvature influences light

Figure 37.3.
Time of round-trip travel between two geodesics responds to oscillations in the curvature of spacetime (diagram is schematic only; symbolic of a laser pulse sent from the Earth to a corner reflector on the Moon and back at a time when a very powerful, long-wavelength gravitational wave passes by; the wave would have to be powerful because a direct measure of distance to better than 10 cm is difficult, and such precision produces a much less sensitive indicator of waves than the vibrations in length [10^{-14} cm or less] of a Weber bar; see exercise 37.7). The geodesics are curved toward each other in regions where the relevant component of the Riemann curvature tensor, call it $R_{\hat{x}\hat{0}\hat{x}\hat{0}}$, has one sign, and curved away from each other in regions where it has the opposite sign. The diagram allows one to see at a glance the answer to an often expressed puzzlement: Is not any change in round-trip travel time mere trumpery flummery? The metric perturbation, $\delta h_{\mu\nu}$, of the wave changes the scale of distances slightly but also correspondingly changes the scale of time. Therefore does not every possibility of any really meaningful and measurable effect cancel out? Answer: (1) The widened separation between the geodesics is not a local effect but a cumulative one. It does not arise from the local value of $\delta h_{\mu\nu}$ directly or even from the local value of the curvature. It arises from an accumulation of the bending process over an entire half-period of the gravitational wave. (2) The change in separation of the geodesics is a true change in proper distance, and shows up in a true change in proper time (see "ticks" on the world line of one of the particles). See exercise 37.6. Note: When one investigates the separation between the geodesics, not over a single period, as here, but over a large number of periods, he finds a cumulative, systematic, net slow bending of the rapidly wiggling geodesics toward each other. This small, attractive acceleration is evidence in gravitation physics of the effective mass-energy carried by the gravitational waves (see Chapter 35).

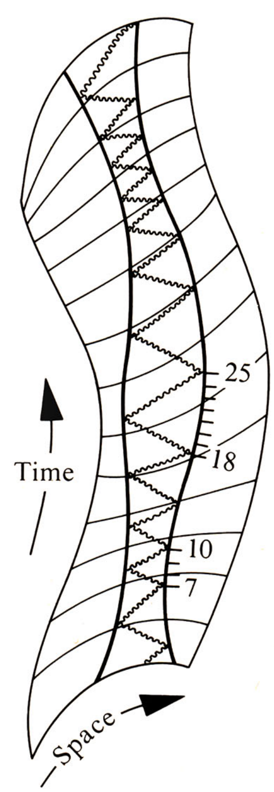


Fig. 18. **Misner, Thorne and Wheeler's Trumpery Flummery:** Back in 1973 the priest-like carnies condescendingly lay down the edict that laser pulses can be used to measure G-Waves. ***At a glance*** this is obvious, right? ***Step right up!*** What gullible fool would trust these guys to tell them the time of day—much less to play fairly when selling a theory of gravity, or a billion-dollar do-nothing machine!? [38]

in a different manner than it influences the mirror separation," because of light's "highest possible speed relative to the inertial reference frame of these mirrors" just doesn't make sense. The "high speed" is *irrelevant*. It doesn't explain Thorne's weird claim that the light "***feels*** *different* ***pieces*** of the spacetime curvature than the mirrors ***feel***." It's just vague, unphysical weirdness.

Overall, Thorne's statement seems to be a mishmash of irrelevancies and nonsense, a murky swamp in which things may hide and from which things may emerge, but ***clarity*** is certainly not one of them. One suspects that ***mudfoggery is the point***. Crucially, in 2002 Thorne *provided no* ***picture*** of whatever the hell he was talking about — because no such picture could possibly hang coherently together. Going back a few decades, along with co-authors John A. Wheeler and Charles W. Misner, in their famous 1973 "Bible" of *Gravitation*, Thorne did provide a rubbery, vertebraic sort of picture of G-Waves (see Figure 18). The text in the caption is revealing:

> The diagram allows one to see at a glance the answer to an often expressed puzzlement: Is not any change in round-trip travel time mere trumpery flummery? Does not every possibility of any really meaningful and measurable effect cancel out? [38]

MTW's "Answer" (grayed) — which foolishly claims an increase in proper distance — boils down to "No, the effect is not canceled, it is measurable." This answer is nonsense because *EVERYTHING* in the G-Wave's path would be stretched and squeezed in the same proportion. There is no *unstretched* ruler by which the alleged stretching can be measured. This simple fact is mucked up by the needlessly (but intentionally?) messy, complex figure.

The muck is thickened by the long-winded caption, which strikes Rotonians as the epitome of *PhDizzix* gaslighting. Can you not "see at a glance" that the hucksters are selling you a real Rolex and not a two-bit fake? Never mind how rapidly they wave their hands or how complicated their example is. Never mind the indecipherable clutter of wiggle upon rubbery wiggle hypnotizing you into submission — disingenuously intimating how stupid you must be to be even slightly suspicious: ***Of course*** observable G-Waves are not "mere trumpery flummery?" I'll take a dozen of 'em!

In uncanny anticipation of the USA's 45th president and grifter-in-chief, since 1973 the authors have hoodwinked thousands of colleagues and disciples to double, triple and quadruple down on their illogical, silly, and obscenely expensive story. The lie is big. If the science of physics were in a healthy state, Wheeler's work in general, and Misner, Thorne, and Wheeler's obnoxious book in particular, would not be celebrated, it would be called out for its abundant circus displays of hero worship, anti-science, and ill-founded gobbledegook. Was Wheeler more of a clown than a scientist? A plunger and a devious, attention-craving clown?

7˙3. *Stiffness of Spacetime*

In the G-Wave business, contradiction is the name of the game. To momentarily play devil's advocate, let's suppose it is possible that "light is influenced in a different manner" than the arms of LIGO and that the lavender wedges in Figures 3 and 4 support the LIGOists' claims. What then to make of Thorne's contradiction with his colleague Peter Saulson, and with his colleagues L. Ju, David Blair and C. Zhao? In their 2000 review paper, Ju *et al* make explicit a consequence of theory and an implication from G-Wave physics as to the "extremely high stiffness of space." Figure 19 displays a few presentation slides (and other quotes) to this effect. Ju *et al* apply the deduced fact of extreme spatial stiffness to conclude that the commonly presented stretch-and-squeeze

> . . . deformation patterns also apply to solid or fluid bodies. The rigidity of normal matter is so low compared with that of spacetime that the stiffness of the matter is utterly negligible . . . The weak coupling [i.e., small effect] of gravitational waves to matter is a consequence of the enormous elastic stiffness of spacetime. [39]

The physical implications of this remark seem to have been lost on its own authors, as they remain loyal to the school that keeps ***hoping to see one thing wobble with respect to something that doesn't***—a discontinuity that dreamily stands out as against the co-joined wobble of matter and space. "If everything is stretching, how do you know anything is stretching? That's the conundrum. It doesn't make any sense." Part of the antidote to big lies is to keep calling them out as such. Building and operating humanity's first Small Low-Energy Non-Collider would put an end to *soooo* much needless suffering. *Oiy vay*, cult devotees are incapable of discerning the difference

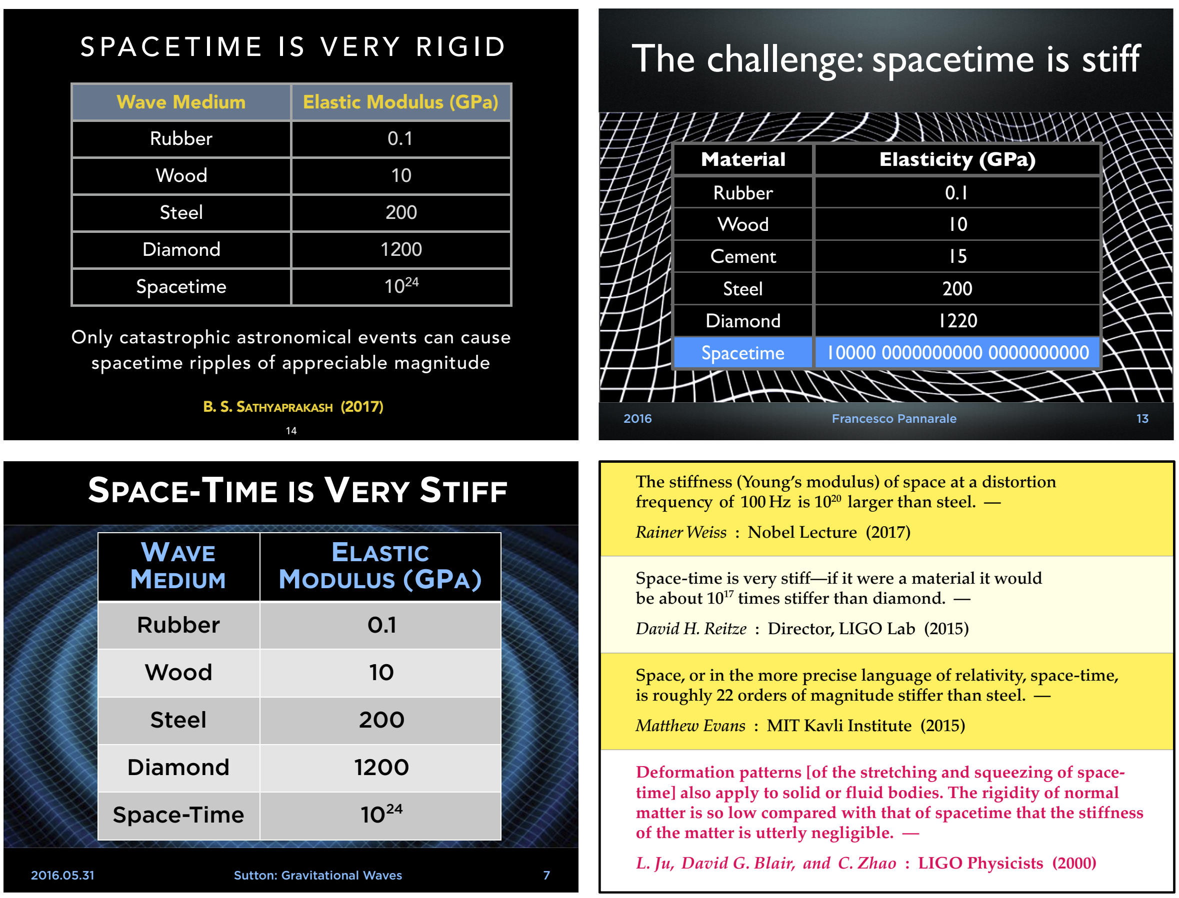


Fig. 19. **Testaments to Continuous Stiffness :** It is essential to understand that the alleged transverse stretching and squeezing produced by G-Waves affects ***everything***. The material structure of atoms and molecules is well characterized by the electric and magnetic fields found therein and beyond. Light itself is also structured by electric and magnetic fields. The spacetime that these fields consist of is therefore affected *continuously as a whole*. It is absurd to claim, as Kip Thorne has, that "because of [its] high speed, [light] feels different pieces of the spacetime curvature than the [LIGO arms and] mirrors feel." [40-46]

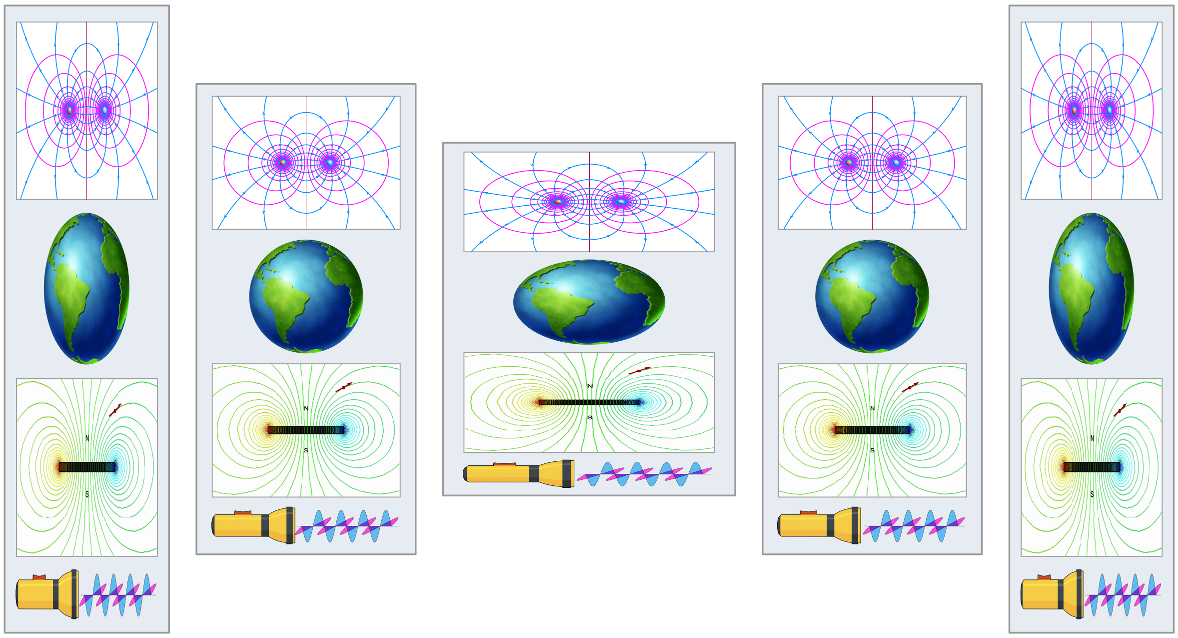


Fig. 20. ***Everything* would get Stretched and Squeezed.** Electric and magnetic fields make both matter and light what they are. The distinction emphasized by Cooperstock is important: Whereas electromagnetic effects take place *IN* spacetime, *gravity IS spacetime*. [47] As the scale may wobble for matter, so it wobbles for light. Therefore, the time required for a light beam to reach and bounce back from the end of a LIGO arm never changes. The signal is perpetually *null*. G-Wavists have never and will never see any G-Waves. As the LIGO technician Rana Adhikari proclaimed: "It doesn't make any sense! This whole thing is bogus! Shut it down!" Alas, they dare not defy the cardinal rule of the Circus: ***The show must go on!*** [48, 49]

between delusion-induced suffering and scientific enlightenment. It's a serious problem.

"Deformation patterns also apply to solid or fluid bodies. The stiffness of the matter is utterly negligible," which means that the deformations caused by G-Waves are *continuous* as across matter, space, and light. Though ***mental*** discontinuities are all too common, there simply is no ***physical*** discontinuity to justify conceiving that the effect on light takes place "in a different manner" from the effect on LIGO's arm, or the whole Planet Earth. See Figure 20.

8. Sticky Bead Nonsense Take 2: Feynman and Hughes Contradictions

Insofar as one single contradiction is ideally sufficient to kill and bury a misguided scientific idea, we are engaged, as noted earlier, in a campaign of relentless overkill. When the ideals of science in practice have become so tortured, when the minds of practicing scientists have succumbed so thoroughly to vague hand-waving, herd-mental baloney, and have grown incapable of perceiving the rot that permeates their potentially noble enterprise, overkill may be just what the doctor ordered. Rotonians are fully aware of the repetitiveness of our presentation. We nevertheless proceed to consider additional examples and variations put forth by the sociological forces that be. For how else are we to counteract them and someday build up a more wholesome and trustworthy scientific environment?

The *sticky bead argument* was invented and promoted by Felix Pirani, Hermann Bondi, and

Richard Feynman in the late 1950s. A concise summary of the origin of the argument and its influence in the field is found in a 2016 paper by Cervantes-Cota, Galindo-Uribarri, and (Nobel Laureate) George Smoot, wherein they write:

> During the discussions, Feynman came up with an argument that convinced most of the audience.
>
> His reasoning is today known as the "sticky bead argument." Feynman's reasoning is based on a thought experiment that can be described briefly as follows: Imagine two rings of beads on a bar [as in our Figure 21]. The bead rings can slide freely along the bar. If the bar is placed transversely to the propagation of a gravitational wave, the wave will generate tidal forces with respect to the midpoint of the bar. These forces in turn will produce longitudinal compressive stress on the bar. Meanwhile, and because the bead rings can slide on the bar and also in response to the tidal forces, they will slide toward the extreme ends first and then to the center of the bar. If contact between the beads and the bar is "sticky," then both pieces (beads and bar) will be heated by friction. This heating implies that energy was transmitted to the bar by the gravitational wave, showing that gravitational waves carry energy.
>
> In a letter to Victor Weisskopf, Feynman recalls the 1957 conference in Chapel Hill and says, "I was surprised to find that a whole day of the conference was spent on this issue and that 'experts' were confused. That's what happens when one is considering energy conservation tensors, etc. instead of questioning, can waves do work?"
>
> Discussions on the effects of gravitational waves introduced at Chapel Hill and the "sticky bead argument" convinced many — including Hermann Bondi, who had, ironically, been among the skeptics on the existence of gravitational waves. [50]

Among the contemporary defenders of Feynman's reasoning is Bernard Schutz (protégé of Kip Thorne) in whose 2017 Edition textbook on GR it is written: "What happens to a ruler when the [G-Wave] hits [is that] in practice the ruler does not stretch at all . . . The ruler can be used to measure

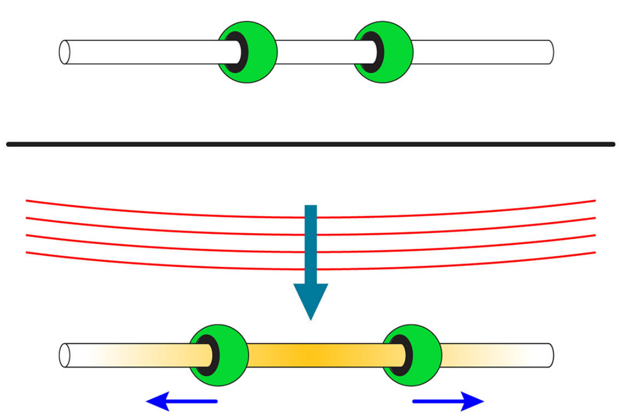


Fig. 21. **The Ubiquitous Sticky Bead Figure:** This figure appears in many documents and presentation slides scattered around the world. As argued by Richard Feynman, Bernard Schutz, Scott Hughes and many others, it represents the idea that the energy conveyed by a G-Wave (downward arrow in the Figure) causes the prominent, transverse motion of the beads along the stick, but only negligibly affects the dimensions of the stick itself. The idea is contradicted by the many LIGO-endorsed narratives saying not only that all the matter of which LIGO's arms are composed is stretched and squeezed by G-Waves, the wavelength of light in the laser beams is affected "by the same factor," as Peter Saulson, e.g., has put it. [52]

the 'stretching of space'." [51] Ten pages later — as we've sadly come to expect — Schutz contradicts himself: "When a [G-Wave] arrives... it will stretch one arm and at the same time compress the other." The "not stretch at all" argument obviously disregards the analyses according to which space and matter are stiffly continuous with each other. The degree to which ***matter*** is stretched or squeezed is practically identical to the degree to which ***space*** is stretched or squeezed. As indicated in Figure 20, there is no discontinuity. Schutz's "not stretch at all" statement contradicts not only his own words 10 pages later, but also the assessment by Saulson and also that of Thorne. Split-brain PhDizzix is on full display. The imagery evoked by these three different accounts do not jibe at all. Thus we confront a state of affairs characterized by graphically incoherent, intolerable contradiction:

1. Thorne: Matter responds to G-Waves like a "rubber membrane," but the wavelength of light is not changed at all.
2. Saulson: The wavelength of light and stick (LIGO arm) deform in the same proportion.
3. Feynman/Schutz: Affect on matter (stick) is negligible due to interatomic forces. ("The ruler does not stretch at all.")

Remarkably, though Saulson's reasoning would seem to indicate that the results of a LIGO interferometer would be null, we find (in what follows) that he ties himself into cringeworthy knots trying to convince himself that the device will actually see G-Waves.

Although the extreme stiffness of spacetime may be taken as an indication that, at a fundamental level, space and matter are indivisible, the *approximate* distinction of one from the other dominates physical existence. The work-producing energy envisaged by Feynman clearly depends on a discontinuity such that at least one set of components of a system acts or responds separately and asymmetrically from the rest, as is the case for virtually all *other* physics experiments. The Universe is replete with stars, planets, sticks, stones, pistons and cylinders, etc.

One of the skeptics featured in Kennefick's book, Fred Cooperstock, argues that the wobble of G-Waves may well exist without the possibility of transfering any energy (similar to the basic concept of Figure 3 and the Top of Figure 4). The continuousness as between matter, space and light, as suggested by many examples from the G-Wave literature, indicates that the wobbly motion of G-Waves, though *calculable*, does not *observably* manifest itself, because the whole matter–space–light continuum wobbles in the same proportion. In this case there is no discontinuity, as needed to "do work," so no *measurable* work is done. Let's consider Feynman's own account from the famous 1957 Chapel Hill meeting:

> I think it is easy to see that if gravitational waves can be created they can carry energy and can do work. Suppose we have a transverse-transverse wave generated somehow impinging on two masses close together. Let one mass **A** carry a stick which runs past touching the other **B**. I think I can show that the second, in accelerating up and down will rub the stick, and therefore by friction make heat. [53]

Feynman then introduces an equation based on earlier work of Pirani, wherein a small quantity η represents a strain similar to the now more common h as we've discussed above. Feynman argues that

> ... the equation says the particle vibrates up and down a little (with amplitude proportional to how far it is from **A** on the average, and to the wave amplitude.) Hence it rubs the stick and generates heat.

Anticipating a reasonable objection, Feynman continues:

> I heard the objection that maybe the gravity field makes the stick expand and contract too, in such a way that there is no relative motion of particle and stick. But this cannot be. Since the amplitude of **B**'s motion is proportional to the distance from **A**, to compensate it the stick would have to stretch and shorten by certain ratios of its own length. Yet at the center it does no such thing, for it is in natural metric — and that means that the lengths determined by size of atoms etc. are correct and unchanging at the origin... I think any changes in rod lengths would go at least as η^3 and not as η so surely the masses would rub the rod.

Feynman is just wildly guessing. Since h is of the order 10^{-20}, h^3 is of the order 10^{-60} — which means Feynman expects a matter/space discontinuity such that stretching and squeezing of the stick is utterly negligible compared to the displacement of the particle (bead).

For the sake of argument, suppose Feynman is roughly correct. If that were the case, then he is starkly contradicted by the many claims that LIGO's arms — including all the steel, concrete and carbon nanotubes they may be made of — stretch and squeeze by the *whole* predicted strain factor $h \approx 10^{-21}$, not the 10^{-40} times smaller effect guessed at by Feynman. Nowhere to be found (to my knowledge) are any calculations that predict an effect that *depends* on the properties of LIGO's material components. Under the assumption that G-Waves are real, the corresponding prediction is that *all* of spacetime — including both matter and light — stretches and squeezes in the same proportion. As Thorne, Misner, Wheeler, Feynman, Saulson, and others have admitted, if this were the case, then the effect, however *calculable*, becomes *undetectable*, in practice.

It is worthwhile to pursue both sides of the argument, to show that LIGOists stumble and contradict themselves — failing all the while to even *try* to support their schtick with a spacetime diagram. On the sticky bead side we next have MIT-based LIGO physicist Scott A. Hughes. Hughes reiterates the transverse–traceless gauge picture, according to which, "*The test masses are unaccelerated to leading order in the G-Wave amplitude h*." [Original emphasis.]

Addressing the inescapable appearance of contradiction, Hughes continues:

> This seems to say that the gravitational wave has no impact! However, the geodesic equation describes motion *with respect to specified coordinates*. Our coordinates are effectively "comoving" with the interferometer's components. Using the fact that our mirrors are at constant position in these coordinates, it is simple to see that the *proper* length of the arms does change. For instance, the x-arm has a proper length... $D_x = L(1 + h/2)$.
>
> One might worry that, in practice, the ruler will vary with the wave, cancelling the measurement. This does not happen because rulers are not made of freely-falling particles: Its elements are *bound* to one another, and act against the gravitational wave. The ruler feels some effect due to the gravitational wave, but it is far smaller than the variation in D_x and D_y... It is enough to note that in essence one uses the (highly stable) frequency of the laser as a clock, and times the light travel in the two arms. We recommend the nicely pedagogical article by Faraoni for a clear discussion, as well as a relatively recent analysis by Finn for more detailed discussion. [54] [Original emphasis.]

Just as Kip Thorne appealed to the irrelevant "highest possible speed" of light, Hughes appeals to a similar irrelevancy; i.e., to the "highly stable frequency" of the lasers. To understand the *physical principle* of an experiment, it is most sensible (and common) to simply assume as given that the technological tools function flawlessly. Mentioning the very fast speed of light and the high stability of one's lasers betrays low-grade sales tactics. Is a would-be buyer of a used car impressed by its being "gasoline-powered"? by its having a "glass windshield" and "rubber wheels"? No. By mentioning these things the sales-person makes a savvy would-be buyer rightly suspicious.

It is certainly ***NOT*** *"enough to note"* the use of lasers as clocks. If one cannot also ***provide a spacetime diagram*** showing ***why*** the times should be different, then it is certainly ***NOT*** *"enough to note"* the use of such lasers to ***time*** the "light travel in the two arms." LIGOists' techy-sounding words and equations are no substitute for a sensible spacetime diagram. They refuse to draw one because they know it would really wreck the sale. Instead they claim to be able to detect G-Waves by merely ***believing*** their undiagramed, explanation-free ***assumptions***. Hughes's hand-wavy ramble is a foggified charade that only *pretends* to explain how the observation is allegedly made. "It is simple to see" the King of Hearts being pulled from behind one's ear — and even simpler to present the equation for the alleged "change in proper length... $D_x = L(1 + h/2)$." It just makes no physical sense. There simply is no unwobbled physical ruler with respect to which the alleged wobble caused by a G-Wave can be *measured*.

Using the new G-wave inspired meanings of *proper length* and *coordinate length*, Hughes clearly contradicts the common description of the material arm and the light waves being stretched or squeezed by the same factor. In spite of the many LIGO-endorsed animations showing LIGO's arms being dramatically stretched or squeezed, Hughes explains that the ruler's coordinate length is *constant* — due to matter's bonding action, which "*acts against* the G-Wave." Whereas the *proper* length supposedly *changes* ***because of*** the ***assumed*** change in "light travel time" of the laser beams. Cause and effect are perversely inverted. With no sensible diagram and no physical reason for the alleged changes in proper length and light travel time, LIGOism is reduced to nonsense.

As though perceiving these logical weaknesses, as though insecure about pushing an incoherent unsatisfying story, Hughes gives up trying to talk his way out of the muddle. Instead, not surprisingly, he lamely hands off the problem for a "clear and more detailed discussion" *to others* — others who paint a similarly vague, mish-mash of words and equations, but provide no sensible picture.

9. Another Hand-Off: Hughes to Faraoni, Finn and Koop

The *others* to whom Hughes refers are a part of the G-Wave research community whose often interlocking web of references can be followed into a morass of dead ends and vicious circles. Surely that must not be our fate. To more unequivocally establish the facts of the matter, we will trace some of the references and pick out representative samples from the literature. For example, Hughes' two references on this point are Valerio Faraoni and Lee Samuel Finn.

Faraoni's often-cited paper is by far the more lucid of the two. He at least explicitly defines the problem. In the course of grumbling about the inadequacy of other works (including those of Saulson, Thorne, and Garfinkle) Faraoni promises a more satisfactory resolution, as suggested by the title of his paper: *A Common Misconception about LIGO Detectors of Gravitational Waves*. Therein Faraoni promises to

> Specifically address the question of "why there is a net effect if the wavelength of light and the interferometer's arm are both stretched?" It would be more gratifying if a direct argument were provided showing how the (proper) length of an interferometer arm and the (proper) wavelength of laser light are "stretched at different rates" by a gravitational wave, which is what we set out to do in this paper. [55]

As one comes to expect in this business, promises are glowing and abundant; deliveries are phony or non-existent. Faraoni's paper appeals to physically unfounded, assumption-infused or irrelevant mathematical analyses, and useless comparisons with cosmological analogies. In the end Faraoni concludes:

> Therefore the objection that "all lengths are stretched at the same rate by the gravitational wave" and based on the analogy with the expanding three-space of cosmology, is incorrect . . . The gravitational wave "treats in a different way" the wavelength of light and the length of the interferometer's arm. Physically, the interferometer works by measuring the differential stretching of the x and y arms; while the high frequency light wave essentially experiences no inhomogeneities in the "medium" in which it propagates — the gravitational wave — because the wavelength λ_{gw} of the gravitational wave is so much larger than the wavelength of light . . . Laser interferometers such as those of LIGO and VIRGO can indeed detect gravitational waves.

And Nixon was not a crook. Why does Faraoni add the bogus cosmological analogy before concluding that "the objection . . . is incorrect"? Would he insist on its incorrectness even if the cosmological analogy were not invoked? Whoever said anything about "high frequency light waves experiencing any inhomogeneities"? As far as I can tell, in every discussion purporting to "clarify the misconception" that LIGO should *not* see gravitational waves based on simple facts about light and matter, the common denominators are bounteous gobs of mud and fog. This impression will be backed up with more examples, as we proceed.

In the present case, Faraoni implicitly approves of Saulson's "explanation" for being "clear and very physical," remaining ambivalent, however, as to explicit agreement or disagreement. More definitively, Faraoni claims his "conclusion agrees with Thorne's qualitative answer to the objection." But his presentation lacks sensible, robust arguments either way. The usual equations are presented with the usual hand-wavy delivery, with the same backward logic. The ***presumption*** of time-of-flight differences means the *proper distances* are changed by G-Waves. "If a gravitational wave impinges on the interferometer, it will cause a phase shift ϕ between the two beams." This is stated as a *fact*, from which the rest follows. But it is not a fact. It is a *guess*, and a rather stupid guess, at that. The rest does indeed follow.

Faraoni does not address the sticky bead argument of Feynman, Hughes, and Schutz. Most revealing — by its *omission* — is the spacetime diagram that any self-respecting physicist would use to defend their argument. The "argument" consists of little more than the *conclusion*: "LIGO can indeed detect G-Waves." The claim is logically empty; a mere prayer without a picture, as though repeating the mantra, in the footsteps of Kip Thorne and Rainer Weiss, makes it true.

The second reference on this matter in Hughes' paper is to Lee Samuel Finn. Finn's affiliation with the G-Wave community goes back to 1992, when he co-wrote a paper whose co-authors included Kip Thorne and Daniel Kennefick. [56] Compared to the above paper by Faraoni, in the 2009 paper cited by Hughes, Finn's analysis is grossly more opaque and equally useless.

Unlike Faraoni, who presented no graphics at all, Finn does provide a figure, patently lame as it is. (See Figure 22.) The primary sin of Finn is the one so commonly committed, which is *stating as a fact*, from the beginning, that in the presence of and due to a passing G-Wave, the travel time of light beams in the LIGO arms *changes*. G-Wavists appear to be unaware that repeating an *assumption* over and over does not turn it into a *fact*:

> A laser interferometer is sensitive to gravitational wave perturbations in the difference in time, as measured at the beam splitter, required for light to propagate along [LIGO's perpendicular arms]. [57]

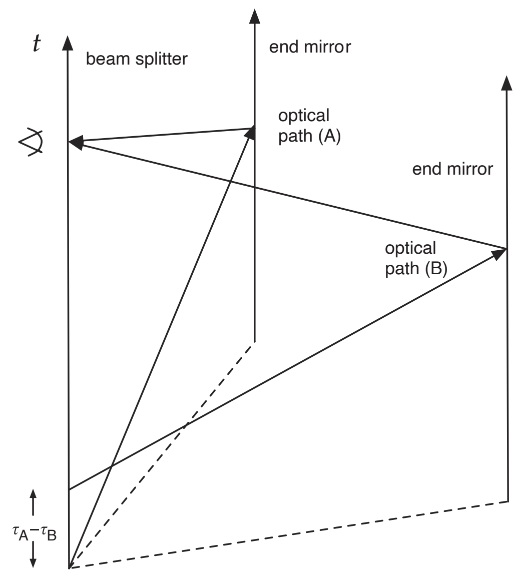


Figure 1: Spacetime diagram of the optical paths in a simple Michelson interferometer. The dashed lines lie in a constant time hypersurface. The observer measures the difference in the phase of light that has traveled along the two different optical paths (A) and (B). In the case of a common, monochromatic light source at the beam splitter this difference is the difference in phase of the light source at times $t - \tau_A$ and $t - \tau_B$.

Fig. 22. **Finn's Question-Begging "Spacetime Diagram":** Finn draws the reflected laser beams in perpendicular LIGO arms arriving back at the beam splitter at the *same* time, although they were emitted at *different* times. Why? The ***crucially missing*** diagram is one showing the effect on a laser beam as a G-Wave is passing through the interferometer, as in Figure 3 and the Top of 4. The latter diagrams make it clear that laser beams reflected off the end mirrors of LIGO arms always take the *same time* to return to the beam splitter, *whether a G-Wave is passing through or not*. Finn's figure confuses more than it clarifies. [57]

Finn never cogently explains *why* we should accept this conclusion to be true. Curiously, in his figure, Finn draws the two perpendicularly propagating light paths arriving back at the beam splitter at the *same* time, but only because he shows them being emitted from the beam splitter at *different* times. Even if Finn's arguments were true, it would make more sense to communicate them by showing the same *emission* time resulting in different *return* times. For the sake of *clarity*, the light paths should be shown intersecting at their *beginning*, not their *end*. Once again we come to suspect that *mudfoggery is the point*.

Finn never addresses the question suggested by Hughes, and spelled out by Faraoni, as to whether G-Waves stretch and squeeze matter by the same factor that they stretch and squeeze the wavelength of laser light. Finn's main concern is that all prior analyses failed to acknowledge a set of mathematical fine points whose neglect would sometimes lead to wrong predictions—were it not for the fortuitously adopted configurations by which the errors cancel, and thus yield for most cases, but just by accident, the "right" predictions. He toots his horn thus:

> Errors, which appear to have remained unrecognized for at least 35 years, render the "standard" derivation inadequate and misleading . . . By a fortuitous set of circumstances, not generally so, the

> final result is the same in the case of Minkowski background spacetime, synchronous coordinates, transverse-traceless gauge metric perturbations, and arm mirrors at coordinate rest. [57]

That Hughes would have referred to this paper by Finn, as though it would shed light on the stretching/squeezing question before us, is one more thing in this drama that illustrates the preponderance, not of cogency and clarity, but of bad advice, confusion and contradiction. Because they can effectively hide in the herd with their colleagues who operate on the basis of the same *folk memory*, ruled by the same godly *group-think idols*, G-Wavists continue abiding by the same decades-old script. Which means that instead of clear-headedly addressing the matter like good scientists, they instead bob and weave and dance around the question of how the LIGO arms and the light traveling therein are "affected in a *different* manner." Or is it the *same* manner, but the light travel time nevertheless comes out as being magically different?

Evidence of LIGO-endorsed, yet contradictory messages is so abundant that, however aggravating this broken-record-like pattern may be, more examples will be presented. Conscientious and diligent readers will thereby acquire an abundance of data with which to understand and see through the game, with all its surrounding and permeating sloppiness and corruption.

Finn's paper was from 2009. It is appropriate to follow up on more recent examples of his work, especially with graduate student and co-author, Michael Koop. In Koop's *PhD Thesis* he reiterates and expounds on Finn's purpose: To make the mathematical analysis of G-Wave observations more general and more rigorous, so that it would give desired predictions for future G-Wave observations. Other proposed methods for observing G-Waves beyond LIGO-like interferometers include, especially the gargantuan space-based interferometer known as LISA, and the so-called Pulsar Timing Array astronomical observations, that are already underway.

In his 2015 *PhD Thesis* [58] Koop presents essentially the same figure as Finn's Figure 1 (our Figure 22). As collected in our Figure 23, we see that, with only slight modifications, Koop repeats the Finn figure several pages after its first appearance (Figure 23B and 23C). Figure 23A is cryptic and inconsequential, whereas Figure 23D is another "spacetime" diagram of questionable validity. One of the distinguishing characteristics of Koop's Thesis is the claim — as first proposed in a 2013–2014 paper jointly written with Finn [59] — that the new, more rigorous analysis contrasts with previous treatments for being "consistent with the equivalence principle" (EP). Whereas those previous treatments are alleged to be *inconsistent* with the EP. It is worthwhile to assess the merits of this claim.

First recall that the EP — its meaning and status in modern gravitational physics — is itself a minefield of mudfoggery (thanks in large part to Einstein's vagueness on the subject). As Callender and Okon have stated: "There are almost as many Equivalence Principles as there are authors writing on the topic." [60] Since the EP is famously associated with Albert Einstein, and most gravitational physicists delight in advertising agreement with it (whatever it means) we immediately recognize Finn and Koop's claim as perhaps nothing more than a *marketing strategy*.

To the average Rotonian, it is not at all obvious that prior treatments of G-Wave analysis *violate* the EP, nor that Finn and Koop's treatment *agrees* with it. Without carefully specifying exactly what they mean by the EP, Koop does write:

> The expression for the response [of gravitational wave detectors] is manifestly consistent with the equivalence principle: i.e., the role of all gravitational phenomena in the response — wave or otherwise — clearly involves measurements made over finite spacetime intervals. [58]

From the above statement it appears that the key characteristic of the EP, according to Koop, is the involvement of "measurements made over finite spacetime intervals." Almost all physics experiments involve measurements made over finite spacetime intervals, so one strains to grasp what makes the Finn/Koop analysis more in line with the EP than other analyses.

Perhaps we can make sense of their claim by considering the more commonly encountered features and consequences of the EP. Tests of the EP itself, for over a century, have mostly involved

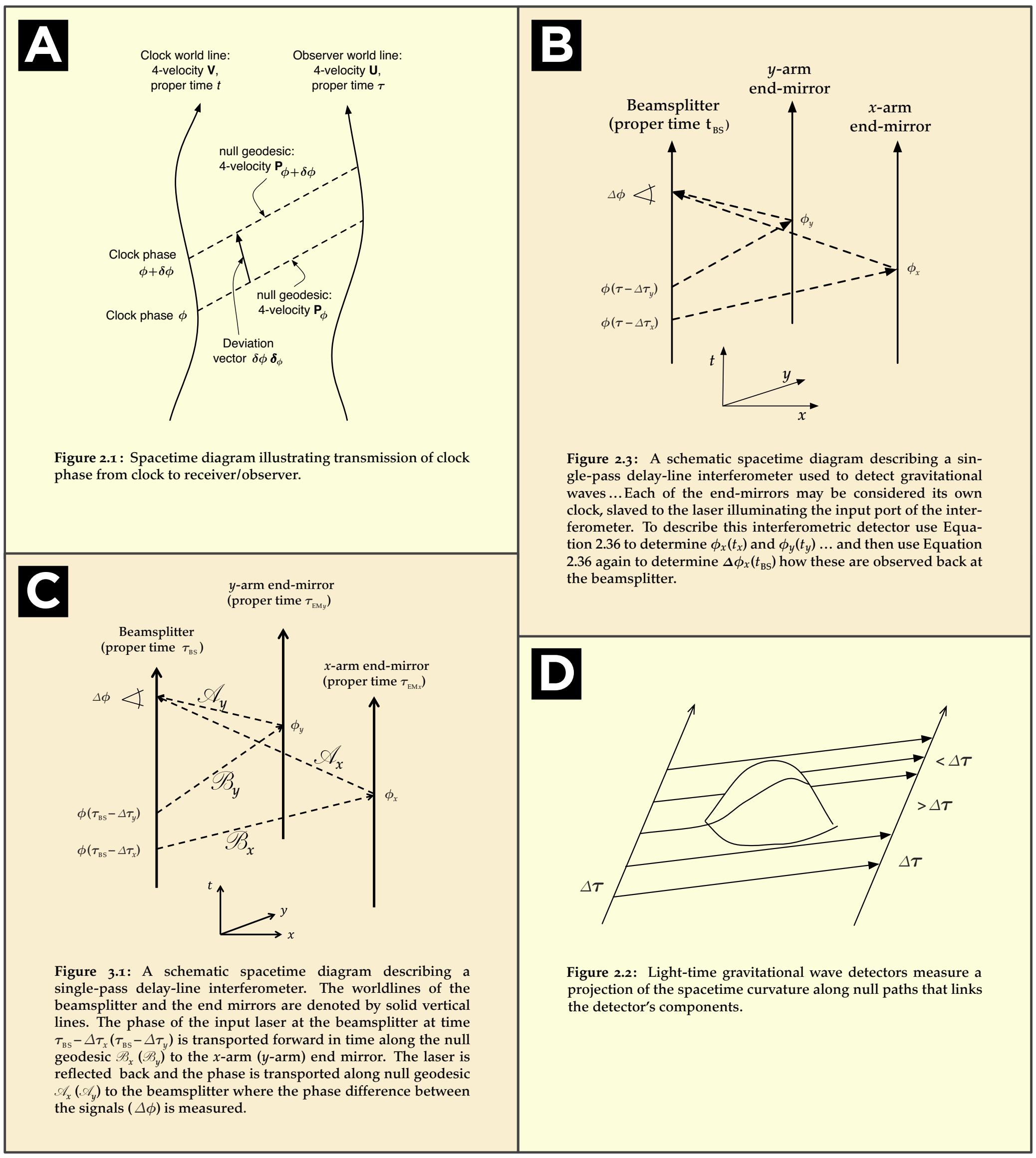


Fig. 23. **Koop's 2015 *PhD Thesis* "Spacetime Diagrams":** The influence of Koop's advisor, Lee Samuel Finn, is evident in the text and the figures. Though **A** is uncontroversial, it is also trivial and needlessly cryptic. **B**, repeated with only slight modifications as **C**—by virtue of its repetition—is implicitly deemed important. Along with **D**, however, none of the latter figures, nor their accompanying text, present any compelling reason to believe what they say. Repetition and popularity do not suffice to make a myth *true*. Like geocentrism, flat-Earth, gravitons or Santa Claus, the alleged measurement of G-Waves—upon careful reflection—makes no physical sense. [58]

comparing the free fall of bodies composed of different species of matter. Evidence of violations of the EP would mean the discovery of free-falling bodies having different apparent accelerations, depending on their chemical composition.

Applied to the case of predicted interferometer responses to G-Waves, Finn and Koop have complained about the different coordinate-dependent descriptions of the end mirrors, as being either in free fall (in the Transverse-Traceless gauge) or sometimes as being accelerated in an oscillatory way with respect to the beam-splitter. In this sense their complaint is like quibbling with the common description of gravity as causing falling bodies to *accelerate downward*, even though accelerometers say they are not accelerated at all. It's like quibbling with the common description of objects attached to Earth's surface as being *at rest*, even though accelerometers say they are accelerating perpetually upward.

Now I would argue that these are indeed valid, even *essential* quibbles. But the most robust and unequivocal way to test and resolve them is by building and operating humanity's first *Small Low-Energy Non-Collider*: To follow free-fall trajectories all the way to the center of a dominant source of gravity. Not by playing word games with abstract analyses and physical apparatus hoping to eke out predictions and effects in the 21st decimal place.

Finn and Koop's analyses may well be more rigorous and general than those of their many colleagues, but the proclaimed deeper loyalty to the EP manifested thereby does not lessen our serious doubts about the whole enterprise, because they still haven't drawn a picture of a G-Wave traversing the interferometer in a spacetime diagram which represents the motion of light with respect to the alleged stretching-and-squeezing effect of the G-Wave. A picture (spacetime diagram) that shows the *stretched-and-squeezed light* taking different times to traverse LIGO's *stretched-and-squeezed arms* is contradictory. So they leave it undrawn. If not decades before, then certainly *after* the 2016 announcement that G-Waves have been "observed," suspicions should have been forcefully raised that something is wrong. But no. The charade just grows more entrenched.

Actual tests of the EP can be brought to bear on the situation insofar as they involve two adjacent or overlapping physical reference frames: The falling object is represented by one reference frame. The seemingly "static" dominant gravitational source (e.g., Earth) is represented by the other reference frame. Both frames unequivocally exist; they both have their robustly physical counterparts, even if their corresponding states of motion are incorrectly perceived. Obviously one of these frames moves with respect to the other in the real physical world. One serves as a kind of *control* system against which to compare motion of the other.

Whereas in the case of G-Waves, *there is no control system*, no second system against which to measure the first. In their abstract analyses, both the colleagues of Finn and Koop and Finn and Koop themselves, have only the ***IMAGINARY*** flat "Minkowski background" to compare with. But this is not a physical thing. There is no physical counterpart. We do not have light abiding by Minkowski space and G-Waves abiding by Reimannian space (nor vice versa). The mathematical Minkowski background exists only in their heads. If G-Waves actually exist, then their physical reality would entail that ***EVERYTHING*** is stretched and squeezed so as to render a physical measurement impossible—as G-Wavists sometimes admit. Therefore, it is more likely that LIGO is a hoax than that it has actually observed the things its operators claim to have observed.

We continue our critique of Koop (and Finn) because of how well their work captures the spirit of prevailing G-Wave research. Focusing again on the superiority of Finn and Koop's Riemannian curvature approach over the "metric perturbation" approach, Koop writes:

> Just as early attempts to understand gravitational waves in terms of metric perturbations led to confusion regarding whether such waves existed or how they might be generated, so attempts to

> describe how gravitational wave detectors respond to metric perturbations lead to wooly statements and, sometimes, outright misconceptions [15–21]. By way of contrast, gravitational waves described as spacetime curvature perturbations are, in a well-defined sense [27, 28], physically unambiguous quantities.
>
> The classical formulation of the response of an interferometer to the metric perturbation generally assumes the special case of a Minkowski background with the beamsplitter and end mirrors at rest in the same global Lorentz frame.
>
> For a gravitational wave in a Minkowski background ... the perturbation to the Riemann curvature can be expressed in terms of the metric perturbation h_{ab} , [58]

where h_{ab} is a G-Wave strain magnitude, as discussed earlier. Rotonians are not convinced that Koop has accomplished anything more than translating the LIGO-ubiquitous "wooly statements and misconceptions" into more sophisticated language. His new and improved Riemannian curvature analysis yields:

> [the] usual result obtained under the same assumptions (Minkowski background, beamsplitter and end mirrors at relative rest, TT-gauge perturbation) using the metric perturbation description of the response. However, while the formulation in terms of the Riemann curvature simplifies to the usual metric perturbation description of the response under these assumptions, it does not require these assumptions to be valid. [58]

Notice the curious expression, "For a gravitational wave in a Minkowski background." Whether a G-Wave is propagating through a given region of space or massive bodies are nearby, *in neither case is there a* ***physical*** *reason to suggest the* ***existence*** *of a Minkowski background*. Koop and Finn and most other G-Wavists invoke the existence of this imaginary thing to rationalize the idea that the speed of light is unaffected by the G-Wave in the sense that its *speed* remains equal to c with respect to the Minkowski grid (i.e., the abstract thing in their heads). If light speed $= c$ with respect to the imaginary grid, and the number of Minkowski-scale tick marks separating the ends of the arms along this grid changes, well then this would explain the different flight times of the laser beams. And if pigs had wings... LIGOists desperately need something like this to be true. Or else the flight times will be equal and their billion dollar contraption will detect nothing more important than the trucks rolling through the Louisiana woods or the Washington desert.

LIGOists envision, in effect, that the stretching and squeezing caused by the G-Wave adds time and distance for the stretching phase and takes away time and distance for the squeezing phase. This can only happen if it's not really stretching and squeezing, not really an expanding and compressing rubbery ruler, but rather a ruler to and from which tick marks are discontinuously added or subtracted. That's how they envision the proper length of the arm increasing and decreasing: with respect to an imaginary, unphysical, discontinuous Minkowski-grid. Conceiving the increased and decreased path lengths (number of tick marks) in this way corresponds to increased and decreased propagation times because the space through which the light supposedly travels is *not* subject to any stretching and squeezing. The magnitude of the effect they predict, and a graphic image of this verbal description, is well-characterized by the lavender wedges in Figures 3 and 4. G-Wavists do not draw these diagrams themselves because that would be like trying to sell M. C. Escher's *Waterfall* to City Hall as a useful urban renewal project. (See Figure 24.) Gazing upon such Figures (3 or 4) might *expose* all kinds of wooly statements and outright misconceptions. The wooly statements and misconceptions might thereby of themselves evaporate. The Figures might illuminate the fact

Fig. 24. **One of M. C. Escher's Famous Brain Teasers — Waterfall (1961) :** Optical illusions are fun, stimulating and harmless, because with a moment's study, everyone figures out that they cannot correspond to the real physical world. They are based on tricks that reveal the potentially hazardous relationship between the eye and the brain and the tons of perceptual baggage that humans inevitably accumulate. The purpose and the existence of the LIGO Collaboration must of course pretend to be benevolent. But it depends on its participants and its audience to be taken in by a decades-old pyramid scheme and Escher-like illusion. It is not sustainable. In the long run such businesses are neither fun nor harmless. They are wasteful and pernicious. [61]

that a "gravitational wave in a Minkowski background" makes even less sense than a "Geocentric Solar System."

Whereas the above paragraph expresses in English the upshot of what LIGOists like Koop and Finn *do* — English that evinces a clear picture — LIGOists themselves say it like this :

> When the gravitational waves can be described as gauge independent curvature perturbation of a background spacetime, the wave contribution to the response is wholly embodied in an integration of a projection of Riemann curvature tensor perturbation along specific null geodesics of the unperturbed spacetime. [58]

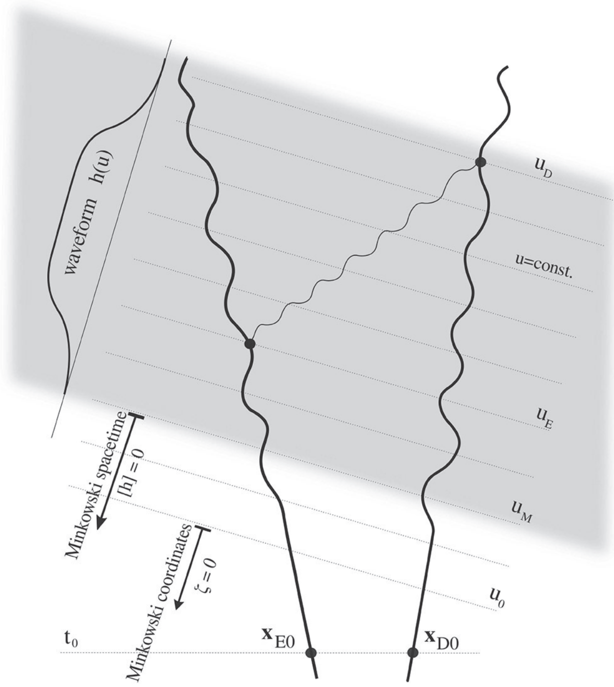


FIG. 1: Spacetime diagram of the experiment. The world lines of observers (thick lines) and light ray (thin line) are depicted. Initial conditions are fixed (with respect to Minkowski coordinates) before the [gravitational] wave arrival.

Fig. 25. **Spacetime Diagram of Questionable Value and Purpose by Arkadiusz Blaut:** The wiggly "world lines" veer away from one another because the "experiment" involves the exchange of laser signals between *moving* objects, not between mirrors fixed in a firmly mounted interferometer. Why add such complexity before resolving the question of what happens in the much simpler case of an interferometer with fixed mirrors? Why not first draw a figure more like our Figure 3 or 4? Is mudfoggery the point? [62]

"Null geodesics of the unperturbed spacetime" means light beams in the imaginary flat Minkowski space characterized by straight, 45° (or 45°/4) angled paths, as the unphysical lavender wedges in Figures 3 and 4. Such things do not exist in the real physical world, in the world populated by large bodies of matter. No matter how LIGOists embroider it with geeky math-speak, or infuse and scramble it with gimmicky Equivalence Principle mudfog, their convoluted gobbledegook makes no physical sense. No physical sense at all.

One more thing. Another example of a puzzling mishmash of cryptic wiggles is found in a recent paper by Arkadiusz Blaut in the prestigious journal, *Classical and Quantum Gravity* (Figure 25). His spacetime diagram is supposed to represent laser signals exchanged between an emitter and receiver that are *in motion with respect to each other*. Why would anyone bother to complicate matters by introducing an utterly impractical apparatus before having clarified how the simplest conceivable apparatus works? Start with a *simple* diagram like our Figures 3 or 4, and take it from there. If the LIGOists' prediction can walk, maybe it can run. Or perhaps it becomes obvious that it can't even crawl. It's not even alive.

10. Official LIGO, Amber Stuver and the Mirror Suspension System

Readers will by now see that G-Wavists' treatment of their subject is seriously flawed: Nothing like a model of clear and robust scientific communication. Happily, having gone well enough into some of the nitty-gritty details, as expressed in academic papers and *PhD Theses*, it becomes much easier to recognize and understand the narrative as found in less technical presentations, such as LIGO FAQ pages, physics blogs and other media intended for more general audiences.

We find that our central question is a recurring subject, and that the expert responses — being intended more for the general public — are typically "dumbed-down" to the point where the mud-fog is easier to identify as such. *It's all about hand-waving, circular logic, and the pretense of confidence.* Curiously, we sometimes also encounter evidence (subtle though it may be) of wavering, meekly delivered "answers," indicative of experts who, in their delivery, appear to be trying to *convince themselves* with their flimsy arguments, as though in the back of their minds they suspect that their clay-footed heroes have not been telling the truth.

We have opened a window on decades of erudite faux fizzix, revealing a tragic community of "scholars" (better characterized as *believers*) beating a dead horse. Are they not insanely persisting to coax the poor animal to fly, if only beaten enough? Like belief in a magical super-powered deity, the spectacle is not sustainable in the long run. That most members of this community have convinced themselves that their strategy has already worked only amplifies and prolongs the grotesque tragedy. Using publicly-funded state-of-the-art theatrical equipment (the smoke and mirrors of LIGO) they keep cranking out the illusion of flying horses.

It's cringeworthy. Most importantly, most revealingly, as we've come to expect, none of the authors provide a spacetime diagram to support their case. For to do so would be to pull the rug out from under their own feet, to force themselves to use their own capacity for critical thinking, which seems to have atrophied to near the point of non-existence.

We begin with screen shots of an official LIGO animation that shows LIGO's arms being stretched and squeezed (Figure 26). [63] Overlaid on the LIGO images are labels pertaining to the length of the arms and to the wavelengths of light — the latter being illustrated by a superimposed wave-train. The information content of Figure 26 is nearly the same as that of our spacetime diagrams, Figure 3 and the Top of Figure 4. As per Saulson's assertion that the wavelength of laser light is transformed in the same proportion as the arms themselves, a tick-marked ruler would also be transformed, indicating that these *proper* arm and wave lengths — if equal in the *absence* of a G-Wave — *never measurably change* even in the *presence* of a G-Wave:

$$L_y = L_x \qquad \text{and} \qquad \lambda_y = \lambda_x \qquad \text{(G-Wave or not)}\,. \tag{4}$$

This assertion of *constant equality* is perfectly consistent with the possibility of *calculating* (*coordinate*) length changes when we invoke an *imaginary* static grid (Minkowski background) as a basis for comparison. Being imaginary, however, the length changes in the results of the calculation have *no measurable counterpart in physical reality*. **No measurable counterpart in physical reality.** *These* are the *"coordinate effects"* that negate the validity of the whole enterprise, whose faulty premise is that the time–of–flight of the laser beams changes due to a passing G-Wave.

Just as Earth's motion through the medium of light propagation was invisible to Michelson's original interferometers back in the 19th century, any G-Waves passing through Earth will remain permanently invisible to LIGO's Michelson interferometers. The long and gnarly myth that G-Waves have been observed dozens of times already is made yet more gnarly by some accounts of a design feature of LIGO that we've not yet discussed. It's the design of the *suspension system* of

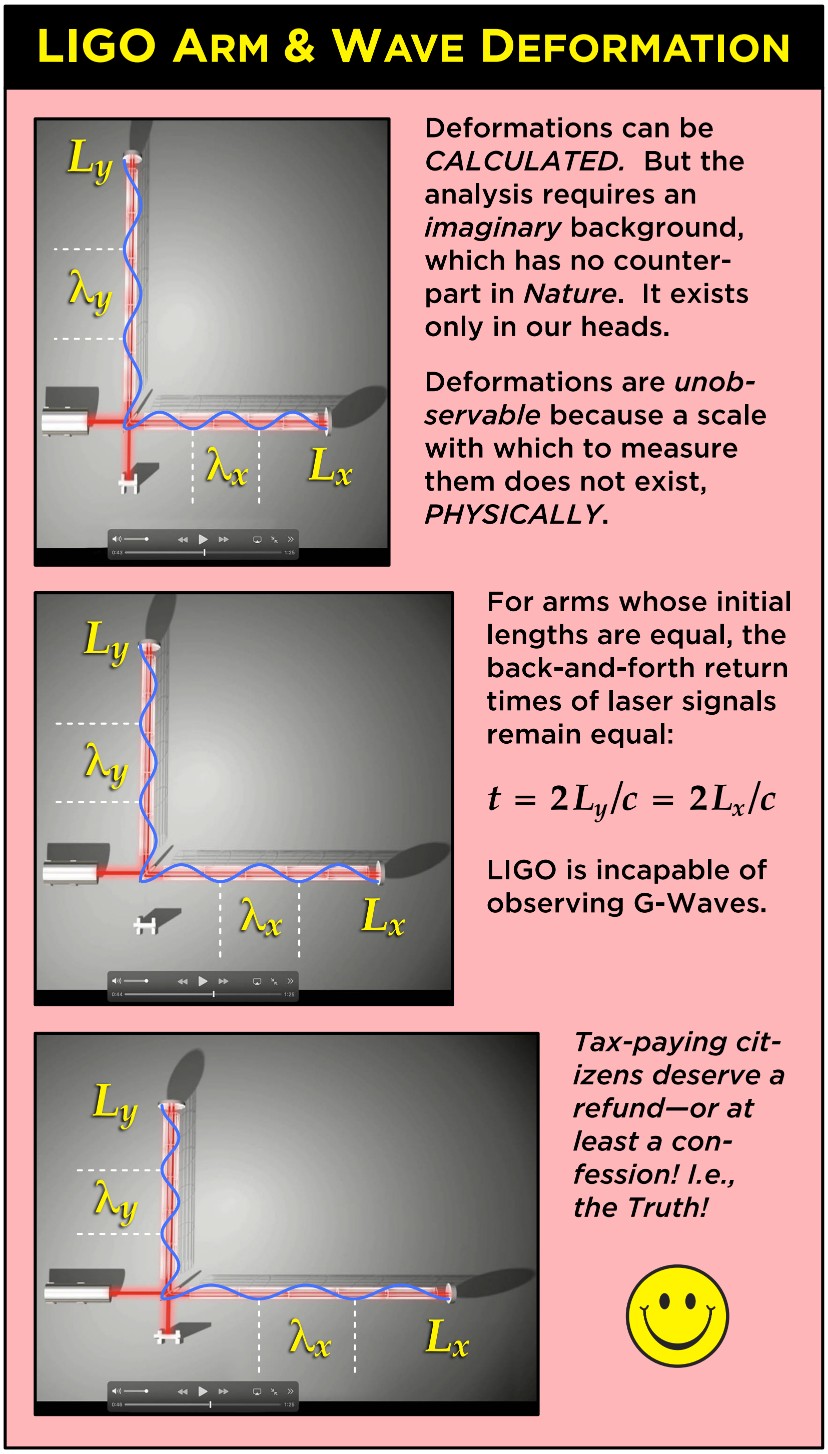


Fig. 26. **Official LIGO Animation of Stretched and Squeezed Arms:** Being unconcerned about the blatant contradiction with Feynman's *sticky bead argument* (whose logic is supposed to have launched the whole enterprise) LIGOists animate the arms of their interferometer, being alternately stretched and squeezed by a G-Wave. Blue wave-trains and yellow labels have been added. Though Saulson and others state that the material structure of the arms and the wavelengths of the laser light are changed by the same factor, many G-Wavists contradict this statement. If the light and the matter do both get deformed in the same proportion, it makes no sense to say that the back and forth travel times of the laser beams would ever change. Notice that the beam source is also stretched and squeezed. *Everything* is stretched and squeezed in the same proportion. The result should therefore be *null*, tragically lucrative boondoggle pork-barrel notwithstanding. [63]

LIGO's mirrors, as depicted in Figure 27.

The mirrors are supported by delicate silica fibers and a marvelous jumble of high-tech optical paraphernalia. The purpose of all that intricate hardware is to damp out the plentiful sources of noise, so as to allow any *bona fide* G-Wave signal to stand out enough to be found in the data. Unfortunately, the impression is sometimes given that the suspension's purpose is two-fold: that it's not just for noise damping. For example, in Amber Stuver's review article ("book") about LIGO, she implies that the system is needed to assure that the mirrors would qualify as "freely falling test masses," as members of the family of geodesic trajectories in the Transverse Traceless coordinate system (aka TT-gauge):

> In the TT gauge, coordinates are defined by the world lines of freely falling masses. Therefore the test masses used in our interferometric detector need to be freely falling in order to respond to a strain. This is done by hanging the test masses (mirrors) as pendula that are 'freely falling' in the direction parallel to the laser beam for the small distances being measured. [64]

As we recall, however, spacetime is so extremely stiff that virtually all of matter — LIGO's arms, planet Earth, etc. — is in "free fall" with respect to a G-Wave. *Everything* responds to the strain of a passing G-Wave.

Observing a G-Wave requires a discontinuous contrast between that which wobbles and that

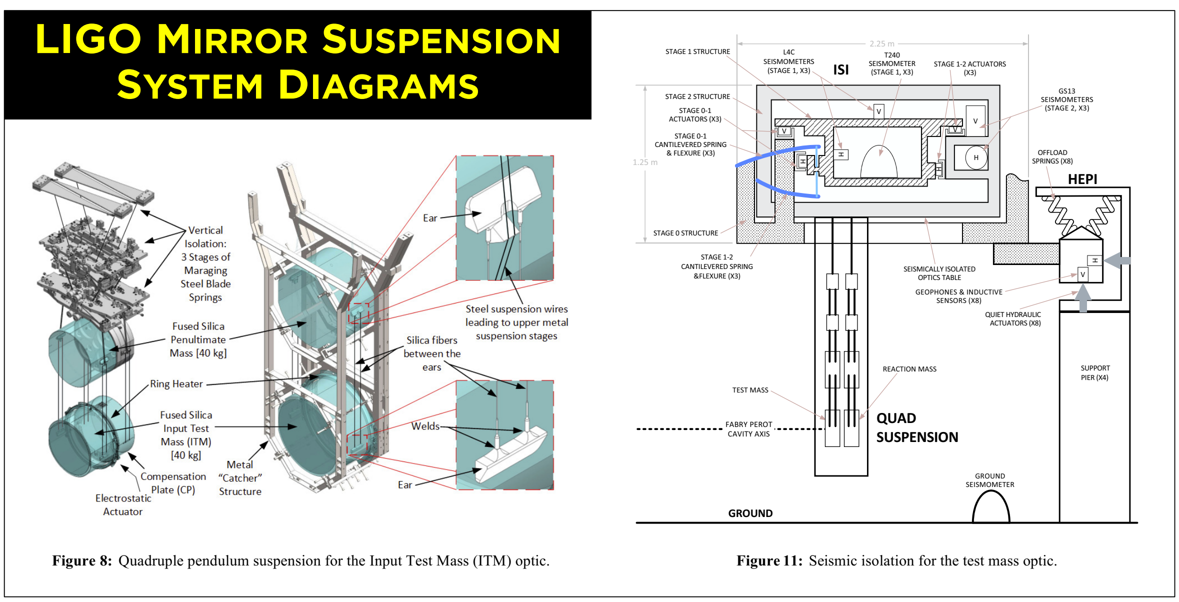


Figure 8: Quadruple pendulum suspension for the Input Test Mass (ITM) optic. **Figure 11:** Seismic isolation for the test mass optic.

Fig. 27. **Advanced LIGO Mirror Vibration Isolation Design:** The technically impressive document from which these figures were borrowed explains in detail the many sophisticated engineering methods used to isolate the test mass mirrors from noise and vibrations that would hinder detection of G-Waves. Nowhere does the essay state or imply that the gross material structure of LIGO's arms is *ideally* any less "freely falling," (i.e., any less capable of "responding to a strain"; any less susceptible to the full influence of a passing G-Wave) than the suspended mirrors. The only reason for striving to isolate the mirrors is all the unwanted activity of the environment. If the mirrors were located at the ends of material tubes that were free of all such environmental noise, there would be no need to isolate them from the tubes. As we recall, the tube's material structure is "utterly negligible" with respect to the extreme rigidity of spacetime and its continuousness with matter. [65]

which does not. Contradicting the possibility of meeting this requirement, Ju, *et al* state, for example, that "deformation patterns also apply to solid or fluid bodies. The rigidity of normal matter is so low compared with that of spacetime that the stiffness of the matter is utterly negligible." With respect to a G-Wave, a diamond ring, the finger wearing it, and all other nearby objects and surrounding space are as one continuous medium. Neglecting their local motions with respect to one another, they all qualify as points in free-fall in the TT gauge. In other words, the gross material structure of LIGO's arms is *ideally* just as "freely falling," (i.e., just as capable of "responding to a

Fig. 28. **Official LIGO Earth Wobble Video:** "Gravitational waves stretch and squeeze the fabric of space and time on very minuscule scales; visually exaggerating these effects reveals how Earth is squeezed and stretched." Which is to say, ***everything*** *gets stretched and squeezed*. There is no discontinuity between matter and space or between matter and light, such as would be needed to physically ***measure*** the effect. The effect can be ***calculated***, not measured. [66]

strain," just as susceptible to the full influence of a passing G-Wave) as the suspended mirrors. The only reason for striving to isolate the mirrors is all the unwanted activity of the environment. If the mirrors were located at the ends of material tubes that were free of all such environmental noise, there would be no need to isolate them from the tubes, as stated in the caption of Figure 27.

To further illustrate the point, consider another official LIGO video showing how the whole Earth wobbles in response to a G-Wave. (See Figure 28.) In the text on the LIGO website it states: "Gravitational waves stretch and squeeze the fabric of space and time on very minuscule scales; visually exaggerating these effects reveals how Earth is squeezed and stretched." Under the usual assumptions as to the physical characteristics of G-Waves (which we question) this statement is not especially unreasonable, as something that can be *calculated*. But the very picture of the whole of Earth wobbling in concert with the "stretch and squeeze of the fabric of space and time" evokes strong doubts as to the *measurability* of the effect, because the *proper* lengths of all rulers and light wavelengths remain the same. We recall Kip Thorne responding to the question:

> [Does] the wavelength of the light in the gravitational wave get stretched and squeezed in the same manner as the mirrors move back and forth? If that is the case, then obviously you won't be able to see the motion of the mirrors using light. [37]

Most of Thorne's colleagues appear to agree with Saulson, that "the wavelength of the light in the gravitational wave [***DOES***] get stretched and squeezed in the same manner as the mirrors move back and forth." If the "fabric of space and time" *wobbles*, it means that light waves traversing through the deformed regions conform to the wobbling. Only if there is a *discontinuity* between the effect on matter and the effect on space would it be possible to *measure* the effect. Peter Saulson and most LIGOists (including the authors of the above video) implicitly acknowledge spacetime stiffness. But if words mean what they say, then this effect would, in Thorne's words, make it *impossible* "to see the motion of the mirrors using light." Like victims of cult indoctrination, ***G-Wavists pretend to not understand the meaning of words.*** They appear oblivious of the many contradictions.

For example, they don't catch the fallacy underlying Amber Stuver's claim that the mirrors at the bottom of LIGO's pendulums respond to G-Waves differently from the pivot points at the top, where the pendulums attach to the surrounding material structure. According to their own words, if local noise is neglected, then the mirrors and the pivots *do not* respond differently. The pendulums isolate the mirrors from noise; they do not affect the "response to a strain" induced by a G-Wave. Stuver's discussion implies an utterly false distinction. G-Wavists are either confused, deceitful, selectively ignorant, or all of the above.

Another example of contradiction and gross misunderstanding is found in a lecture by Harry Collins, the sociologist who is well known for embedding himself among LIGOists for decades and writing books about the enterprise. In this lecture Collins also makes a point of establishing that his expertise in the technicalities and the physics of G-Waves is comparable to or better than that of many physicists.

With the intent to convey the small observable magnitude of the effect of G-Waves, Collins uses the example of a black hole binary coalescing at the distance of the Sun:

> If you'd been at a distance of our Sun from this huge emission of energy, all you would have noticed would have been a slight bang in your ears, as the bones in your ears were moved slightly by the gravitational wave passing by. [67]

This is nonsense because it requires something to wobble against something that supposedly does not wobble. All of the matter in your ears is "utterly negligible" as against the stiffness of spacetime.

So as *everything* wobbles, there is no way to *physiologically feel*, much less ***measure*** that *anything* wobbles. It's really quite simple; a simply called out tangled web of a billion dollar boondoggle.

The enterprisers persist with their delusion, in defiance of all logic. LIGOism is an extreme instance of committing ***The Fallacy of Misplaced Concreteness***. They pretend the *totally abstract thing* referred to as the *Minkowski background*, is real. LIGOists are so numerous, they are immersed in so much cultish group-think brain-washing, so much investment of time, prestige, and money, that they are impervious to rational arguments.

This "style of thinking" can be traced back to Albert Einstein. Remember that Einstein argued that even rotating observers have a logical claim to being in a *state of rest*. The whole Universe rotates around every single rotating observer with an infinitude of different speeds with respect to an infinitude of different axes. A healthy physics community would have called Einstein out on this absurd "relativistic perspective." Instead, renowned Oxford scholars like Julian Barbour celebrate the madness:

> What is almost breathtaking and lends his theory such grandeur is the way in which he consistently applied the lesson he had learnt from special relativity — namely, to achieve the result you want, do not be afraid to tamper with space and time. In fact, it seems to me that Einstein exhibited an almost ruthless willingness to do just whatever he pleased to space and time provided only he could then show that the laws of nature would take exactly the same form at every point of space-time and in any frame of reference in which he might care to examine them. [68]

"To achieve the result you want," just invent your own reality. This is the disease from which gravitational PhDizzix suffers. The site of the most serious infection is arguably the G-Wavist community, as they "exhibit an almost ruthless willingness" to claim reality for an *imaginary* Minkowski background spacetime. If their phantom doesn't really exist, then they cannot observe G-Waves. But LIGOists desperately ***want*** to observe G-Waves, so they ruthlessly carry on (to the tune of a billion dollars) as though the imaginary background *must* exist. It's insane.

11. Official LIGO, U Birmingham, Cassandra Hunt, LIGO FAQs

Another instance of inconsistency in the LIGO saga is found on the LIGO-affiliate, University of Birmingham website. There we find a highly polished animation video, one of whose segments models a LIGO interferometer arm with a lengthening and shortening laser beam. (See Figure 29.) Curiously, the light beam is depicted adjacent to a strip of ruler-like tick marks which, however, do not participate in the length changes; they remain static. Astute viewers are thus left to wonder whether the material arms of LIGO are also stretched and squeezed (multiplicatively, in the same proportion — or additively and discontinuously, somehow gaining and losing tick marks in the process).

How can the length of the laser beam fluctuate in size but the tick marks adjacent to it just sit there? Why is it that LIGOists can't get their story straight? *Why don't they **draw** the relationship between the light beams and the material arms as they respond to a G-Wave on a **spacetime diagram**?* Mudfog. The dominant signal in their message is mudfog.

The next noteworthy instance of a promise to clarify that backfires, is Cassandra Hunt's blog called: *A Subtle Misconception About How LIGO Works*. [69] As we will see, the "misconception" is about as "subtle" as a freight train. Hunt begins with the bugbear question:

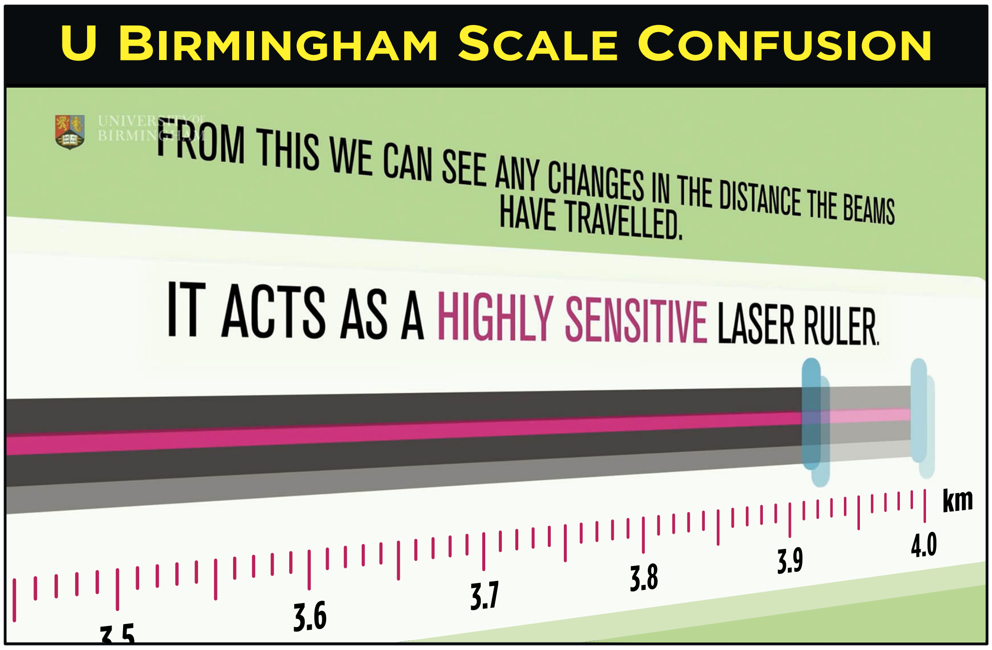


Fig. 29. **LIGO-Affiliate, University of Birmingham Adds Mudfog to the LIGO Arm Question:** In this well-produced video we are informed that the *lasers* in LIGO's arms serve as "highly sensitive rulers." But as the laser beam itself gets squeezed and stretched, the tick marks etched on the arm below the beam do not get deformed in concert; they remain static. How can that be? What are we to make of this? Is the idea that the *light beams* qualify as accurate rulers but the *material arms* do not? Did they just *forget* to include the tick marks in their animated motion? If we are to trust LIGO's other official video (Figure 26) showing the arms themselves being stretched and squeezed, then we rightly wonder whether "we can [***really***] see any changes in the distance the beams have traveled"? Whether measured by light beams or matter, whether stretched or squeezed, the LIGO arm "laser ruler" remains exactly 4 km. The video obscures all comprehension. Such sloppiness and inconsistency in the telling of the story suggests that mudfoggery is the point. [70]

> If a gravitational wave contracts and expands space, shouldn't the light wavelength be affected in the same way as the interferometer arm distance? If so, how is the wave detected at all?

She continues by admitting embarrassment, setting up a lamely attempted "answer," failing to provide a spacetime diagram, and immediately deferring with the routine handoff to others:

> We were all tripped up by the question, which was a bit embarrassing considering the table [of experts] included a guy who studies the CMB, a guy who studies black holes, and me, who actually briefly worked on LIGO. However we were perhaps redeemed in that it appears to be a question that comes up a lot and has produced a handful of papers on the subject. (This article is based on two of them: Faraoni and especially Saulson.)

It is worthwhile to discuss one element in Hunt's answer that ubiquitously appears whenever this embarrassing problem arises: *the speed of light*. In her section ironically called "Resolving the Contradiction," Hunt explains that, as a G-Wave stretches one of LIGO's arms:

> Each crest [in one of the arms] now has further to travel through the interferometer . . . The wave-crests still propagate at the speed of light. So the wave crest arrivals are still delayed compared to what they would be without the added path length . . . Since the speed of light is constant, the return time of the photons will be determined by the distance they travel . . . The time difference in the arrival time of the photons from each arm will be proportional to the length difference in the arms. [69]

This description is most easily understood by referring to the Bottom of our Figure 4 (p. 13). The middle lavender wedge corresponds to Hunt's reference to the lengthening phase of the G-Wave and the side wedges correspond to the shortening phase. Hunt does not deny the idea that LIGO's arms are stretched and squeezed (as a scale change). But she lapses onto the other side of her brain—the addition-of-tick-marks side—to address the speed of light. To "explain" the time difference of laser beam arrival, Hunt tacitly requires the beams to maintain their speed with respect to the utterly imaginary Minkowski grid, not with respect to the G-Wave stretched grid. With respect to the static Minkowski grid the number of tick marks between LIGO's mirrors increases or decreases. But they are only ***imaginary, calculated*** tick marks, not ***physically real or measurable*** tick marks.

Imagining the speed of light to $= c$ with respect to the imaginary scale, yields the delusional calculation that the return time delay of the laser beams will indeed fluctuate, depending on the phase of the G-Wave. Notice that this conception corresponds to laser trajectories with *constant angles* on the spacetime diagram. Neither Hunt nor any other G-Wavist draws this picture because they know, like Escher's *Waterfall*, it makes no physical sense. Minkowski-space tick marks cannot logically be added and subtracted at will, just to conform to the belief that G-Waves should be measurable.

More sensible are graphics showing the whole physical arm getting stretched and squeezed (as in the official LIGO idea redrawn as our Figure 26 or the Top of Figure 4). In these Figures the number of tick marks, i.e., the ***proper length, remains unchanged.*** More sensible than laser beams conforming to a magically G-Wave-unaffected static grid is that the speed of light $= c$ with respect to the G-Wave stretched and squeezed scale. The scale-change conception corresponds to laser beams whose spacetime diagram angles conform to the wobbly scale of space. (Top of Figure 4.) It follows that the time for the wave-crests to traverse LIGO's arms remains ***constant*** ($t = 2L/c$). Neither LIGO nor any other "G-Wave detector" is actually capable of detecting G-Waves. "The whole thing is bogus. Shut it down."

Since Feynman's 1957 genius prediction that G-Waves "do work," and should therefore be observable in principle, its blessing by the likes of Herman Bondi, John Wheeler, Joe Weber, Charles Misner, Kip Thorne, and Thibault Damour has resulted in a throng of cultish followers that has emerged to prostrate and contort themselves with all manner of "explanations" for how it must be true. ***It's all nonsense.*** They have scrambled the meanings of terms like *proper* distance, *coordinate* distance, and *geodesic deviation*, and have woven them into contradictory word salads, unphysical mathematical waveform analyses, and contradictory lectures and "clarification" documents. In the end, all we get is a non-sensical, hand-waving muddle. G-Wave or not, the back and forth time of a laser beam in a LIGO arm remains the same: $t = 2L/c$. The LIGO empire is a Potemkin Village, destined for an ignominious end, which cannot come soon enough.

LIGO's Frequently Asked Questions (FAQs) pages on their websites are another clearcut source of confusion. In 2018 I happened to visit one of their FAQ pages a few weeks before they changed it, to give a new (one might have hoped, honest) answer. A separate LIGO webpage also includes the same question. Two of these FAQs are thus still accessible. The Q part of the question reads:

> If a gravitational wave stretches the distance between the LIGO mirrors, doesn't it also stretch the wavelength of the laser light?

Of LIGO's three answers, the first paragraph of the first (no longer accessible) one (from September 9, 2018) reads:

> A gravitational wave does stretch and squeeze the wavelength of the light in the arms, but it turns out that doesn't matter. What matters is how long the laser beams spend traveling in each arm. When a gravitational wave passes, it changes the lengths of the arms, which changes how far each laser beam needs to travel before being reunited with its partner beam. [71]

On September 29, 2018 the same web address gave a new answer — which is still current — the first paragraph of which reads:

> While it's true that a gravitational wave does stretch and squeeze the wavelength of the light in the arms *ever so slightly*, it does **NOT** affect the fact that the beams will travel different distances as the wave changes each arm's length. And the only thing that matters to LIGO is how far the beams travel in each arm before being merged once again. [Original emphasis.]

Our critique on these answers may be anticipated, based on our breakdown of Cassandra Hunt's weblog just above. A third official LIGO answer — that is still accessible on a different LIGO webpage, one without the explicit Caltech affiliation as in the first two — adds a new (illogical) twist:

> A gravitational wave does stretch and squeeze the wavelength of the light in the arms. But the interference pattern doesn't come about because of the difference between the length of the arm and the wavelength of the light. Instead it's caused by the different arrival time of the light wave's "crests and troughs" from one arm with the arrival time of the light that traveled in the other arm. So the laser light is acting not so much as a ruler, but as a stopwatch. Read more about this interesting question. [This last sentence is hyperliked to Amber Stuver's blog, which links to yet other experts, none of whom resolve the matter.] [72]

In this third FAQ "answer" it says: "But the interference pattern doesn't come about because of the difference between the length of the arm and the wavelength of the light. Instead it's caused by the different arrival time of the light wave's crests and troughs." LIGO's arms are 4000 m long and the wavelength of its lasers is 1064 nm. ***Neither the difference nor the ratio between these numbers has anything to do with the question at hand.*** So why bring it up? Look at how the statement fits in the paragraph. This absurdly irrelevant fact is raised as a *straw man*; as if critics or truth-seekers suffer from the idea that the difference between these numbers is relevant.

In all three "answers" the desired conclusion is stated without explanation: *G-Waves change the return time of the laser beam.* (So there.) "Doesn't a G-Wave also stretch the wavelength of the laser light?" In the context of their own theory, the correct answer is: "Yes, therefore G-Waves are unobservable." But their Gods and marketing gurus have trained them to respond otherwise. Being put on the spot by the question, LIGOists try to wriggle out of it, as they attempt a rescue by their old saw: the rationally unsupported *presumption* that a time–of–flight difference suffices as an answer. As though "G-Waves change the return time of the laser beam" are magic words like Abacadabra. Essentially the same maneuver is attempted on the LIGO FAQ pages. It's just an amateurishly performed shell game. No logical or scientific methodology. As if con-artistry and mudfoggery were the point. It's pathetic.

Being a problem, evidently, with the depth and potency to "trip up" Dr. Cassandra Hunt and her expert colleagues, we the public surely deserve a more rational answer than what's been given.

Hunt's answer appeals to the "cosmology analogy." It includes confusing illustrations of some superimposed before/after wave-trains. More irrelevancies and distractions. Ultimately, her readers are left stranded in a cloud of nonsense. Pretending to have triumphed nevertheless, Hunt, in effect, claps her hands with satisfaction, as though having explained her way out of embarrassment: "So there we have it!" In case you're still confused, read Faraoni and Saulson to wallow in a yet deeper swamp of murky mudfog; and be sure to not ask for a spacetime diagram. ***Your confusion is our busine$$!***

12. Peter Saulson's Cringey Plea

A focussed treatment of Peter Saulson's work on the subject is in order, as we approach the close of our failure-to-provide-a-spacetime-diagram argument. Since 1997, when Saulson published his *American Journal of Physics* paper: "If Light Waves are Stretched by Gravitational Waves, How Can We Use Light as a Ruler to Detect Gravitational Waves?" [73] he has arguably written and lectured on the subject more than any other author. Since 2004 Saulson has referred to the problem as the *Rubber Ruler Puzzle*. [74] His thesis has evolved but little, spanning the years when LIGO was only

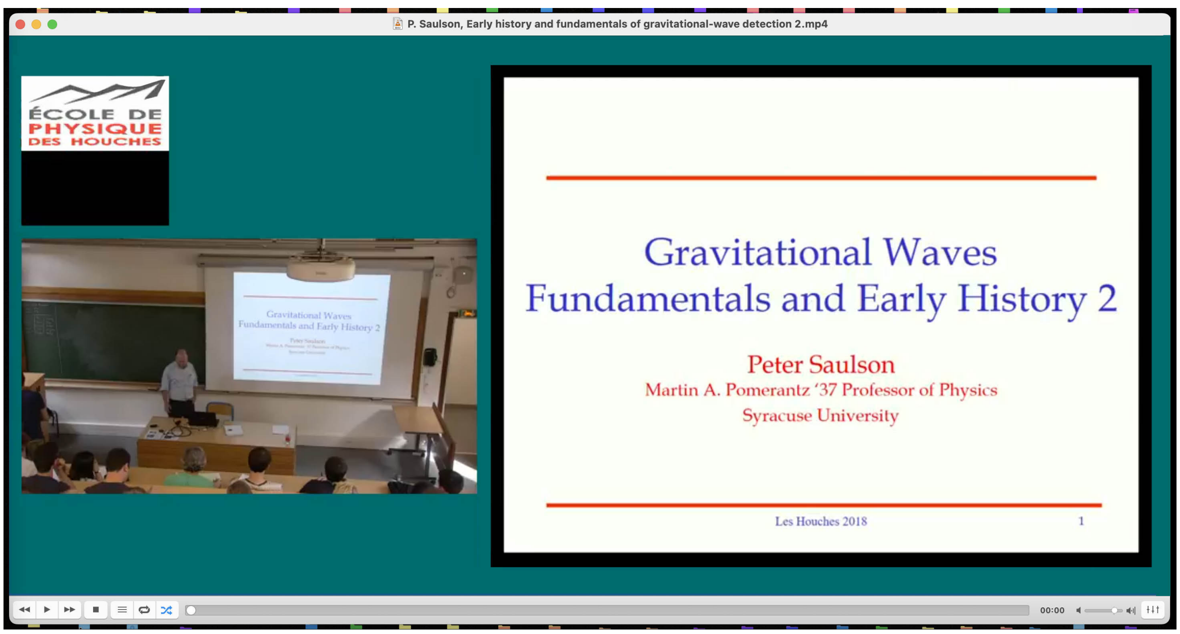


Fig. 30. **Peter Saulson Lectures in France, 2018:** Opening view of lecture. Time stamp ▶ 00:00. Saulson devotes about 20 minutes of this lecture to what he calls the "Rubber Ruler Puzzle." Saulson implies having suffered "night sweats," in an effort to explain the puzzle. A poll of the audience reveals that many of them have also worried about it. While lecturing, he draws something on the chalkboard that is not resolvable in the video and not represented in his slides. The much-needed spacetime diagram (Figures 3 or 4) plays no part in the lecture, which is instead sprinkled with nonsense. (See Figures 31–33.) As though trying to convince *himself*, Saulson concludes with hollow assurances that "this whole thing is [NOT] a giant mistake." It's much too big an *investment* to let logical reasoning reveal it as a monumentally embarrassing hoax. [75]

under construction, to its coming online and to after G-Waves have supposedly been abundantly observed.

On the 4th of July in 2018, almost three years after the first alleged observations, Saulson delivered a lecture that was video-recorded at *Ecole de Physique des Houches*, in the French Alps. [74] See Figure 30. Before going into details of the talk, I should first like to commend Saulson for drawing so much attention to the problem. He presents certain facts of the matter well, sometimes going into excruciating detail, spelling out the unlikeliness that there is actually an acceptable answer. For this healthy skepticism, Saulson's work is almost heroic.

But Saulson's story is also one of tragedy. For in the end he doubts the veracity of his own critique — not because his initial suspicions were ever invalidated, but because (it seems to me) his *subservience to authority* has caused him to succumb to *believing in* and to being bullied into trying to explain the existence of Santa Claus. Saulson behaves as a *willing victim of gaslighting*. And the cycle of abuse sadly repeats. Let us then ponder key points of Saulson's lecture to assess whether this judgment is too harsh, or not.

The admirable humility of Saulson comes across in some of his introductory remarks:

> One of my main goals . . . is to cause you to question deep in your soul whether, given the numbers involved in the strength of gravitational waves in their interaction with detectors, whether it could possibly be possible for us to detect them or not . . . If you have not spent at least one half hour of your life convinced that this whole thing must be a giant mistake, then you don't deserve to be then appreciating how fabulous it is that we've accomplished this. [Time stamp ▶ 2:10 – 2:28.] [75]

In these introductory remarks Saulson also foreshadows our main subject:

> I would like to question whether we have left out something crucial. And the name I give to that questioning is the Rubber Ruler Puzzle. [Time stamp ▶ 01:30 .]

After presenting a variety of mathematical preliminaries, Saulson returns to the question of the laser light in LIGO's arms as a G-Wave passes through. He explains the two most popular descriptions: The TT–gauge variation that treats all points of the LIGO arm as unmoving, and the variation preferred by Weber, that treats the arm as being subject to a transversely wobbling, distance-proportional gravitational force. Allowing that both descriptions have validity, Saulson comes to the key question:

> Isn't there an effect both on the light and on the test masses? And if so, isn't the gravitational wave somehow made unobservable? Let's think that through. [Time stamp ▶ 32:24 .]

Before presenting Saulson's convoluted "explanation" for why the effect of the G-Wave "both on the light and on the test masses" supposedly makes G-Waves *observable*, nevertheless, consider the detail that he adds to the problem, and the query he makes of his audience (see Figure 31):

> The intuition that motivates the [Rubber Ruler Puzzle] is okay. I filled the arm of an interferometer with a light wave, and it has, you know [sic] pick a wavefront. Every wavecrest, okay, those are the tick marks on the ruler.
>
> And when space is expanded by the action of the gravitational waves, is it not the case that the separations between those tick marks on my ruler have lengthened? And if my ruler stretches every bit as much as the arm, it would seem that I have constructed a situation where, um, where the effect of the gravitational wave is unobservable.

> Raise your hand if either today or some time in the recent past, you've had this worry. [In the mostly cropped video frame, six raised hands are visible. (Figure 31.) Presumably many more are also raised.] Okay. Good. Alright. So let's talk it through together . . . That's a legitimate worry. In the end, it's not a legitimate problem. [Time stamp ▶ 32:39 – 34:22 .] [75]

Although Saulson presents a robust collection of doubts that cast a dark shadow on the whole G-Wave enterprise (Figure 32) he proceeds to muddy the situation by invoking the analogy from cosmology that we've encountered before. Let us forthwith dispose of this analogy as nonsense. Point locations — i.e., galaxies — in GR-based Big Bang cosmologies, are sometimes regarded as moving away from one another and sometimes as each one being in a state of rest (free fall). Preference for one point of view or the other Saulson likens to a matter of *theology*:

> So it's a kind of a . . . becomes a theological dispute whether you want to say that there is motion in an expanding Universe, or not. [Time stamp ▶ 37:00 .] [75]

Supposedly, Saulson argues, LIGO's arms are analogous to the cosmic distribution of galaxies and their treatment in standard Big Bang cosmology. It's a bad analogy. We can see this by supposing the existence of a cosmically long rigid ruler. One of the tenets of standard cosmology is that

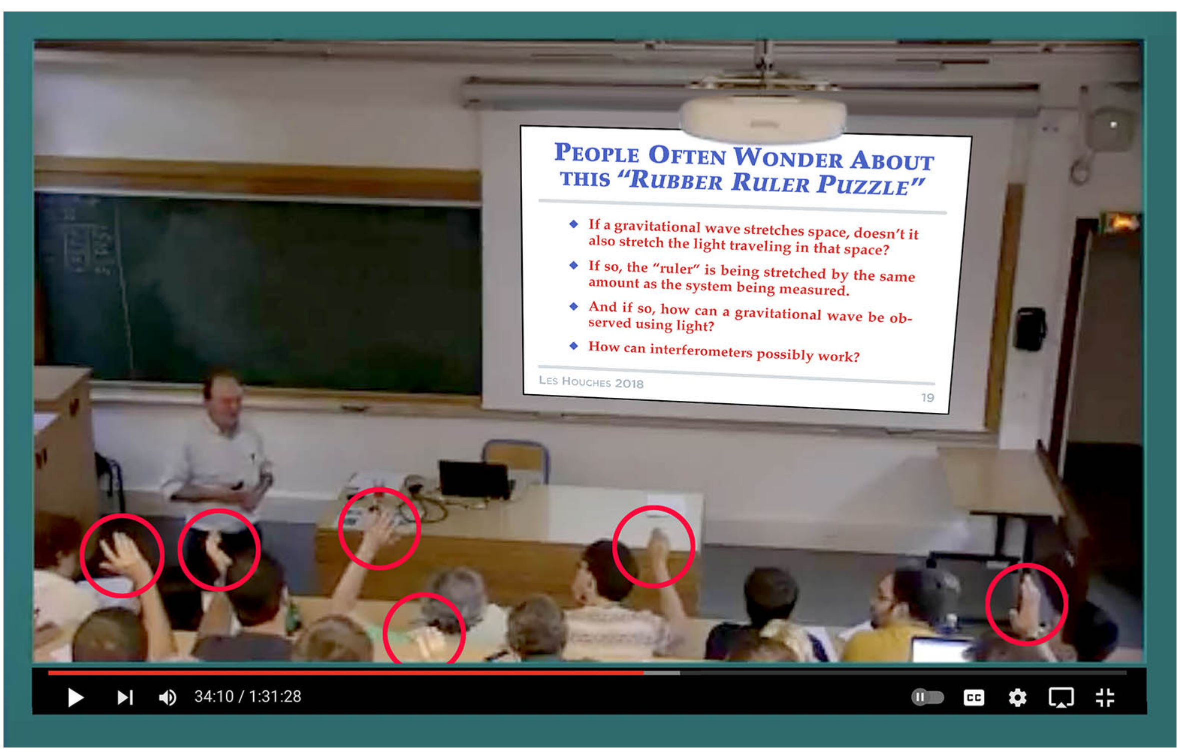


Fig. 31. **Peter Saulson Asks for Audience Input:** "Raise your hand if either today or some time in the recent past, you've had this worry." This "worry" being the *Rubber Ruler Puzzle*. "How can interferometers possibly work?" [Time stamp ▶ 34:10] . [75]

even individual galaxies within groups or clusters will not exhibit cosmological expansion with respect to one another because these are locally *bound* systems. Only *unbound* systems, separated by much larger distances, are supposed to participate in the global cosmological expansion, as more and more new space is created and the density diminishes in inverse proportion. The fact that the density is supposed to decrease over time by itself refutes the analogy. It's no excuse that measuring the decrease would take many millions of years. It is supposed to happen. It cannot happen without the galaxies *moving* away from one another. It is patently *not* a "theological" question. The alleged behavior of LIGO's arms is ***NOTHING*** like the pattern of motion in Big Bangist cosmology.

At the risk of overkill, therefore, let's consider another argument that falsifies the analogy. Suppose the ruler we introduce is a strongly bound system, such as a tick-marked carbon nanotube or a rigid rod composed thereof. This is a permissible structure that we can easily imagine as indicating the distance between widely separated objects. Since there is no restriction, in principle, to overall length, we suppose this tick-marked ruler to span many hundreds or thousands of megaparsecs. Any stress such a ruler suffers is negligible. It is much more tightly bound than any cluster of

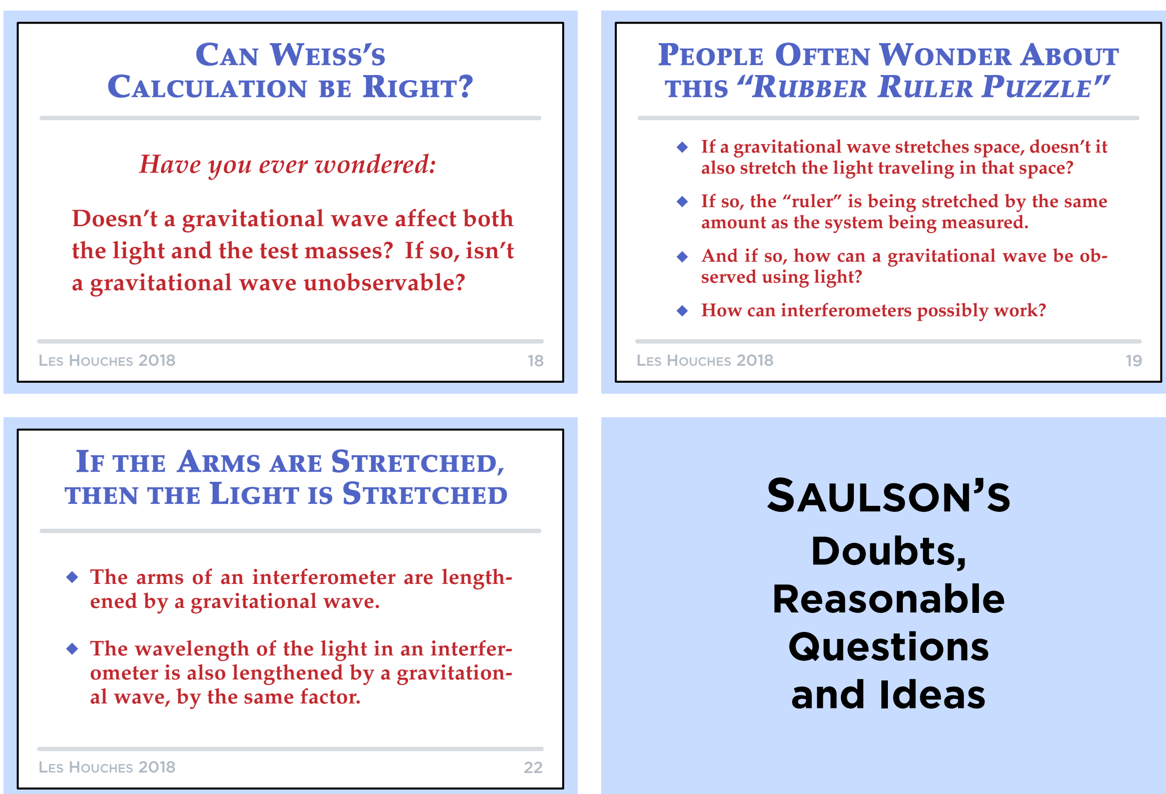


Fig. 32. **Peter Saulson 2018 Lecture — Reasonable Slides:** Saulson asks some important questions stemming from the common assertion in the G-Wave community, that "The arms of an interferometer ... and the wavelength of the light in an interferometer [are both] lengthened by a gravitational wave, ***by the same factor***." Tragically missing from Saulson's lecture and the rest of the G-Wave literature is a spacetime diagram demonstrating that these assertions definitively indicate that, however mathematically "right" Weiss's ***calculation*** may be, *it does not correspond to **physically measurable** reality*. [75]

galaxies, which are regarded as bound structures (that do not participate in cosmic expansion). For all practical purposes the rod resides *at rest* in the surrounding cosmic fluid in which distances between galaxies perpetually increase, as a result of the alleged initial Big Bang. Recall the simple description of the matter given by A. Zee, in his book *Einstein Gravity in a Nutshell*:

> Big Bang: From No Space to Space. The Big Bang is actually the creation of space: from no space to space, [increasing] . . . by the factor $a(t)$ ever since. [76]

It's a process of volumetric increase that *does not stretch tightly bound systems and their characteristic length scales*, such as a planet, star or galaxy, much less our cosmic carbon nanotube measuring rod. Indeed, it is exactly with such an idealized ruler that we could get an unequivocal motion-revealing measurement of the alleged cosmic expansion. The systematic redshift–distance relation is only *indirect* evidence, that even Hubble did not accept as proof of actual expansion.

Suppose a point near the ruler's "middle" — call it the *origin* — corresponds to a cluster of galaxies whose individual motions with respect to the tick marks are only local, not revealing any cosmological recession. But all other parts of the ruler, many megaparsecs distant, will reveal this systematic motion away from the origin. With respect to a distant galaxy, the number of tick marks *increases at a greater rate* — the galaxies fly by the ruler with ever increasing speed — the further they are from the origin. Suppose our Galaxy is located hundreds of megaparsecs from the ruler's origin. Suppose the ruler passes near Earth. If the Big Bang model were true, we would then be able to visually see our motion with respect to the ruler. The apparent speed of the ruler would correspond to the redshift-deduced recession speed of a galaxy near the origin with respect to the Milky Way. This is an accurate picture of the standard *model* of cosmology, however *physically inaccurate* the model may turn out to be.

But it is not at all similar to what is alleged to happen in LIGO. *In no case* do LIGO's arms and the laser beams within them — in response to a G-Wave — resemble this clearcut pattern of Big Bangish motion. In the case of LIGO there is no physically principled way to provide a bound ruler that is discontinuous from the predicted pattern of motion, as is needed to actually *measure* the motion. There is no *non-wobbling* ruler as needed to *reveal* any wobbling ruler. There is no increase and decrease in the number of tick marks between the ends of LIGO's arms. The laser beam bouncing around therein is clearly (as Saulson often states) subject to the same scale-changing effect. A G-Wave can never cause tick marks to be added or subtracted out of nowhere (as they are in the Big Bang's discontinuous "creation of space" cosmology). All of the tick marks and all of the light waves get stretched and squeezed in the same proportion. Saulson *says* this, implying that this is how it works *all the time*. But he doesn't believe his own words. Instead, he flails away, groping for some loophole by which it isn't really true, at least *some* of the time.

However "theological" the whole Big Bangist scheme may be, it is *absurd* to claim that it does not involve rapid expansive motion — motion that is *measurable* not just indirectly as a redshift, but *in principle*, using physical, tick-marked rulers. Inventing an illogical "analogy" that mis-characterizes the *obvious motion* in the Big Bang hypothesis as *debatable*, is an act of *desperation*. Saulson and other G-Wavists (e.g., Cassandra Hunt) are *desperate* to find some way to get rid of the pesky Rubber Ruler Puzzle. So they grasp at straws. Big Bang cosmology is a fertile source of straws from which to vainly claw out some "resolution" to the *night sweat–inducing quagmire of contradiction*. (See time stamp ▶ 45:14.)

Undeterred by logic, Saulson presses on. His next strategy is to create a special kind of G-Wave, a "step function" G-Wave that arrives suddenly (reminiscent of the "wave" represented in Andersen's absurd diagram (Figure 5). This maneuver is just a distraction; just more desperate, irrelevant *texturing* of the shells in the same old clumsily executed shell game. Some useful detail is nevertheless provided, as we see in what follows:

> After the arrival of the step, after $t = t_\circ$, suddenly my arm is longer, and it stays longer for the rest of the situation that I want to analyze. So let's think about the light wave in the arm. [Saulson refers to his chalkboard sketch, but this is not visible in the video and is not included in his slide presentation.]
>
> It must be the case that at $t = t_\circ$, plus the tiniest increment, that the wavefronts move in the same proportion. So that a wavefront that was immediately adjacent to the beam splitter is still immediately adjacent to the beam splitter. A wavefront that was immediately adjacent to the surface of the mirror at the end of the arm is still immediately adjacent to that [mirror]. And that everything moves proportionally in between. If that were not the case, we would . . . [trails off] The only other way you could invent a rule would be to have some background spacetime. And ***there is no such thing***. So I've changed the ***scale factor*** of my arm, and ***all the light is stretched by the same scale factor***. [75] [Time stamp ► 40:13–41:32]

At this point Saulson defers again to his cosmological analogy and shifts the discussion from changes in ***spatial scale*** to "travel time differences." Scribbling again on the chalkboard, Saulson continues:

> What it looks like after $t = 0$ ($t = t_\circ$): These beams that were just about to reach the beam splitter and superpose, have changed negligibly. So, immediately after $t = t_\circ$ there is no travel time difference impressed between the light in the x-arm and the y-arm. [Turning to the class for dramatic effect, Saulson exclaims:] Uh–oh! Are we about to get in trouble? No! Because if we wait a little while it's this beam [pointing to chalkboard] this wave crest and this wave crest that make it back here. [75] [Time stamp ≈ 42:42–43:35]

Saulson then lapses into an incomprehensible ramble about how a batch of "new fresh light" and subsequent wave crests "arrive a little late." Or *early* for the perpendicular arm. He refers to his chalkboard sketch (of which there is no published record, to my knowledge) mentioning wave positions that somehow get increasingly out of sync. But the whole schtick requires accepting a magical discontinuity — causing the laser beam to be suddenly no longer affected by the G-Wave even though it is continuing to affect LIGO's arms. The mental discontinuity is expressed (among other places) at time stamp ► 44:20, when Saulson refers to light that newly enters the arm after one cycle of bouncing has already taken place, as he utters the idea:

> Such a wavecrest samples fully the lengthened arm. [75]

By "samples fully the lengthened arm" Saulson means that it takes a longer time for this light to traverse the arm than before the G-Wave arrived because of the arm's G-Wave-created extra length. Saulson has thus switched from the scale factor side of his brain to the extra-tick marks side of his brain. Even though the space within and around the arm has been stretched, the "new" wavecrest and the laser beam it is a part of, behave as though they have ***not*** been stretched. The space behaves as though it is longer — in the sense that more tick marks have been ***added***. The tick marks have not been ***scaled*** in the same proportion; there are suddenly, magically, more tick marks. Abacadabra! The wave supposedly travels at the speed $= c$, with respect to an unstretched greater number of static Minkowski-space tick marks. So the time to bounce back and forth is increased. It's so stupid! "It doesn't make any sense. This whole thing is bogus. Shut it down!"

The description is wholly incoherent. It cannot be made coherent until it is drawn as a spacetime diagram. In a spacetime diagram both the laser beams and the G-Waves can be clearly tracked. As we have repeatedly seen however, clear tracking is subordinated to mudfog. A clear picture exposes the nonsense. Mudfog provides a place to hide. The mudfog is of course ***SOLD*** as clarification. Remember the whole enterprise was largely launched, or at least blessed, by John A. Wheeler the prevaricating plunger.

In effect, Saulson has invoked an imaginary "background spacetime" about which he has just assured us: "***there is no such thing***." Supposedly, after the initial sudden onset of the G-Wave (which yields the "Uh oh" zero time difference)

> This [waiting] effect builds up until we've waited a long enough time, so that light that was just entering the arms has had a chance to go all the way down and all the way back. And such a wave crest samples fully the lengthened arm. And so over a time that is a duration the round trip light travel time in the arm, the response goes from no response to the full naïve response. [75] [Time stamp ► 43:56–44:42]

Pretending that this "waiting for new light" strategy is consistent with light and matter being stretched and squeezed in the same proportion — *pretending* that this meander through mudfog qualifies as a satisfactory "explanation," Saulson feigns relief:

> So when we had those night sweats about whether an interferometer worked or whether the stretch of the light, um, was uhh, making the effect unobservable, we were guilty of not thinking about the fact that light is traveling. And we were imagining that these tick marks were a frozen ruler. Then all we have learned — and it's actually something worth having learned — is that an interferometer doesn't respond instantaneously. But responds over a time equal to the round-trip travel time in the arm. [Time stamp ► 45:14–46:13]

> Here's my takeaway. We never should have said, we never should have allowed ourselves to be tricked into thinking we were using light at a ruler. The light travel time calculations [by Weiss] were always going to be correct. And it was just a matter of making sure we didn't get tripped up in our heuristic interpretation by momentarily thinking that light is being used as a ruler. It's not. It's being used as a travel–time measuring device, and a travel–time measuring device only. So that's my account of how the Rubber Ruler puzzle is resolved. [75] [Time stamp ► 47:20–48:24]

"The light travel time calculations by Weiss" depend on the idea — as in the analyses of Finn, Koop, Stuver, Hunt, Faraoni, et al — that the speed of light $= c$ with respect to a static Minkowski metric that is made physically real by holy edict. Without this embarrassing, unphysical gimmick, the light waves would not be expected to arrive sooner or later than the logically expected time $t = 2L/c$ (G-Wave or not). The gimmick is a purely imaginary thing. As though providing an unwobbled ruler with respect to which the wobble of a real physical ruler can be measured. It's a mirage; a self-delusion. The calculations are divorced from physical reality. They may well be "correct" *mathematical equations*. They just make no ***physical*** *sense*. "Correct" calculations contradict common descriptions like Schilling's that: "A passing gravitational wave stretches and squeezes empty space and everything in it." Everything in it surely includes light waves. And if this is true, as Thorne has admitted: "If the wavelength of the light in the G-Wave gets stretched and squeezed in the same manner as the mirrors move back and forth, then obviously you won't be able to see the motion of the mirrors using light.” Contradictions abound. It gets tiresome and repetitious. But this is the corrupted state of gravitational physics these days. Exposing the depth and the ubiquity of the rot is an essential first step, if gravitational physics is ever to come clean.

Whatever Saulson was scribbling on the chalkboard during his lecture, it was certainly not a spacetime diagram like Figures 3 or 4. It was surely nothing to remove the painfully obvious contradictions in his convoluted story, because the contradictions are not removable. They are only, perhaps, made a little less conspicuous by covering them with new jargon, as expressed in Saulson’s lecture and slides (Figure 33): “New fresh light,” old “flushed out light,” “step functions,” “instantaneous vs non-instantaneous responses,” “naïve responses,” “DC responses,” wave crests that “sample fully the lengthened arm.” This is all nonsense.

After his lecture Saulson asks for questions from the audience (none of which were audible in the video). After a few that were disposed of fairly quickly, a question was asked that evoked a longer

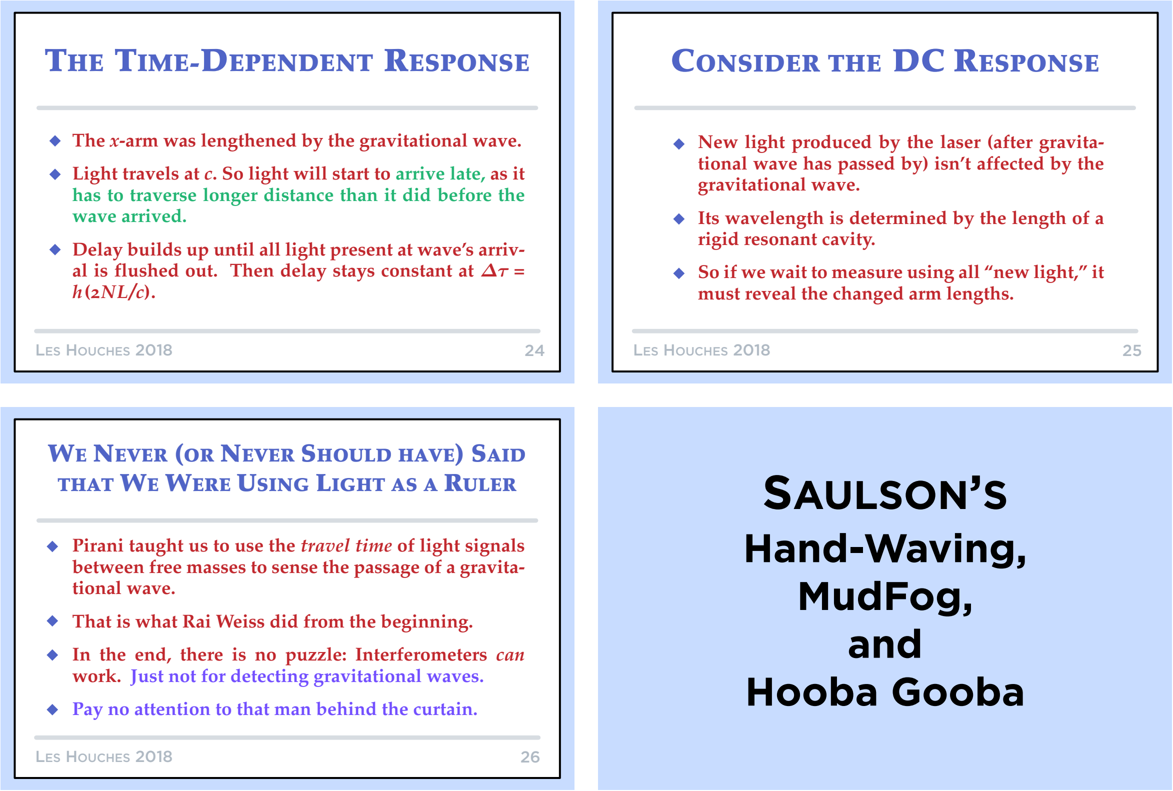


Fig. 33. **Peter Saulson 2018 Lecture — Dubious Slides:** Slide 24: The increased distance the light has to travel is *calculable*, but not *observable*. There is no extra *measurable*, distance (green type) because the ruler and the light are all stretched by the same factor. It’s as though Saulson forgot that he just said this. Slide 25: First point is irrelevant. Second point is false. The wavelength is determined by the electromagnetic and quantum properties of atoms. Third point is nonsense. It doesn’t matter how “new” or “old” the light is. The time to go out and back from the beam splitter is always $t = 2L/c$. Slide 26: Hand-waving, authority-worshipping hooba gooba. (Purple type added.) Saulson concludes with hollow assurances that “this whole thing is [*NOT*] a giant mistake.” It’s much too big an ***investment*** to let logical reasoning reveal it as a monumentally embarrassing hoax. [75]

answer. But it was painful to watch and listen to because it was so full of incoherent nonsense:

> It means that the interferometer is, with this gravitational waveform applied to it, permanently stretched in x and squeezed in y. The light is not stretched. No fresh light. [This appears to be a double contradiction. Ahh, that pesky tangled web . . .] The only light that gets stretched or squeezed by the gravitational effect is the light that was traveling through the vacuum at the time. The new light coming from the laser is coming out as a single wavefront before hitting the beam splitter every period established by the laser's cavity. That's a good clock. And now it gets here and it leaves simultaneously in both directions. And the new light is not stretched. Okay. But the ***new light does feel*** either the longer arm or the shorter arm. And so its response becomes this permanent offset. Okay. Good. Great. Thanks. Thanks for asking. [75] [Time stamp ▶ 50:42–51:40.]

Why exactly is "old" light deformed, but "new light" is not? Where's the cut-off? Why should there *be* a cut-off? The laser just stays on; *all* of its light is "new." All the while that the G-Wave is supposedly passing through, the space it travels through is stretched (or squeezed). If LIGO's arms are stretched, the electric and magnetic fields in that space are all stretched. We are expected to believe that, by some desire-fulfilling mirage, the "new" light coming through nevertheless conforms to the "old" flat Minkowski space, unstretched and unsqueezed (but more or fewer tick marks of it) as before the G-Wave came along? It's not just unbelievable, it's embarrassingly absurd.

Even after claiming that both the arm and the light inside it are "affected by the same scale factor," in the face of the Rubber Ruler Puzzle, Saulson wilts. He now feels obliged to impose an imaginary, discontinuous separation between matter and light, between G-Wave affected (old) light and G-Wave *unaffected* (new) light, as though between a deformable spacetime and an undeformable "background spacetime," even after asserting that "there is no such thing." [Time stamp ▶ 41:24.]

Conspicuously missing amidst this embarrassing charade of an "account of how the Rubber Ruler puzzle is resolved" is the illuminating power of a spacetime diagram. Painful as it is to watch and hear and read and re-write the "content" of this lecture, it needs to be exposed for what it is. In the interest of everyone's mental health, we need to realize when we are being sold a bill of goods, to transcend the state of gaslit PhDizzix that has befallen us. The sooner the better. A good start would be to insist that the authorities produce a sensible drawing of their product, a spacetime diagram showing how it works — or utterly *fails* to work — in the real world.

In conclusion, note that a curious exchange occurred back at time stamp ▶ 33:16. As usual, the question was inaudible, but Saulson's response is revealing:

> It's so much easier than it was three years ago! [75]

The laughter following this quip is due to the fact that "three years ago" was 2015, the time prior to LIGO's first claimed observation of G-Waves. Saulson was then still delivering Rubber Ruler lectures, but without any official evidence to give the needed cover. Unlike those early, pre–"observation" days, Saulson's arguments claiming to prove the existence of Santa Claus — however nonsensical — can now all end with the "successful" exclamation: "*Look! Presents under the tree!*" Dozens of beautifully wrapped fake Rolexes. "It's so much easier than it was three years ago!" Excruciating irony abounds.

13. Derek Muller and Rana Adhikari

Starting in 1979, [77] ambitious physicists began schmoozing with the National Science Foundation to sell LIGO, getting contracts and building the billion dollar boondoggle monument. Seeds were thus planted to inculcate Saulson's efforts to stave off his "night sweats," as he gaslighted his students and himself that the huge interferometers will (and eventually did) detect G-Waves. Consistent with the self-image of the G-Wave community sketched by Kennefick, with its "folk memory" of upright correctness, we discover that marketing G-Waves is a team effort. Being a pretty much united front of propagandists, well-intentioned math geeks and technicians, smartypants charlatans, and gullible hypocrites, rigorously trained members like Cassandra Hunt, Lee Finn, Michael Koop, Amber Stuver, Valerio Faraoni, MIT's Scott Hughes and Rainer Weiss, and many others, appear willing to adopt or accept — or perhaps passively ignore, ostrich-like — Saulson's practiced yet absurd method for explaining away the Rubber Ruler Puzzle.

A well-respected veteran of the team, "one of the leading LIGO scientists" [78] is physicist and technician, Rana Adhikari. Being on board with Saulson's "new fresh light vs. old stretched light" bit, in an interview on the YouTube science show called *Veritasium*, with physicist and video producer Derek Muller, Adhikari does his best to sell the thing. Transcribed from that video is the following segment of dialog. [79] The first 5 minutes of the ten minute piece covers various technical preliminaries about the sources of G-Waves and the apparatus needed to detect them. (See Figures 34 and 35.) A moment after the solo Muller introduces the subject of the Rubber Ruler Puzzle, the video cuts to the duo — Muller (DM) and Adhikari (RA) — standing amidst a jungle of laser lab equipment:

> **DM:** [On-screen solo] Now here's something most people don't think about, which is that gravitational waves stretch spacetime. So light traveling through that space should be stretched as well. If *everything* is stretching how do you know *anything* is stretching?
>
> **RA:** [On-screen together] How do you know *anything* is stretching? That's the conundrum. It doesn't make any sense. [clapping his hands for emphasis].
>
> **DM:** It doesn't!
>
> **RA:** This whole thing is bogus. Shut it down! [Laughter.] [Time stamp ► 05:39. See Figure 34.]
>
> **RA:** [Waxing serious now.] I would send a laser beam down this tube and then wait for it to come back, and then I would say "well nothing happened" because the space got stretched and the laser wavelength got stretched. It's . . . it looks the same if it got stretched or not stretched. It doesn't make any sense!
>
> Well it's sort of a matter of timing, is how it works. So the amount of time it takes for light to go down this tube and come back is very short. However the gravitational wave, when it comes through, it's doing the slow thing, like slow humming [hums]. And it's true, when the wave comes through . . . um . . . **the light which is in there, it actually does get stretched.** [Pause.] And . . . and then that part doesn't . . . doesn't do the measurement for us. But . . . um . . . now that the space is stretched, that laser light is like come and gone. It's out of the picture. We're constantly shooting the laser back into the system, so the ***new fresh light*** now goes through there and has to travel a bigger distance than the light before. And so by looking at how this interference changes with time, and keeping the laser wavelength from the laser itself fixed, we're able to do the measurement. [79]

Let's consider Adhikari's description in detail. "When the gravitational wave comes through, the light which is in there, it actually does get stretched." We have the same question evoked by Saulson's presentation: Why should this not be true *continuously, every step of the way*? Surely it is true for any moment that both the G-Wave and the light are "in there." Muller says as much at the start, "Gravitational waves stretch spacetime. So ***light traveling through that space should be stretched as well***. If *everything* is stretching how do you know *anything* is stretching?"

Perceiving that the laser wavelength changes continuously with the stretching and squeezing of LIGO's arms is facilitated by Figure 26, where we've used the official LIGO animation to superimpose the wave trains over the arms. Imagining that the drawings are animated helps: Stretch • Squeeze • Stretch • Squeeze... The discontinuous "old light vs. new light" schtick requires an absurdly clunky modification of this animation. While LIGO's *arms* are being rhythmically stretched and squeezed, the *light* traveling through them suddenly loses the beat. For no sensible reason, light waves suddenly behave as if the G-Wave wasn't there. Instead, as though a split-brain

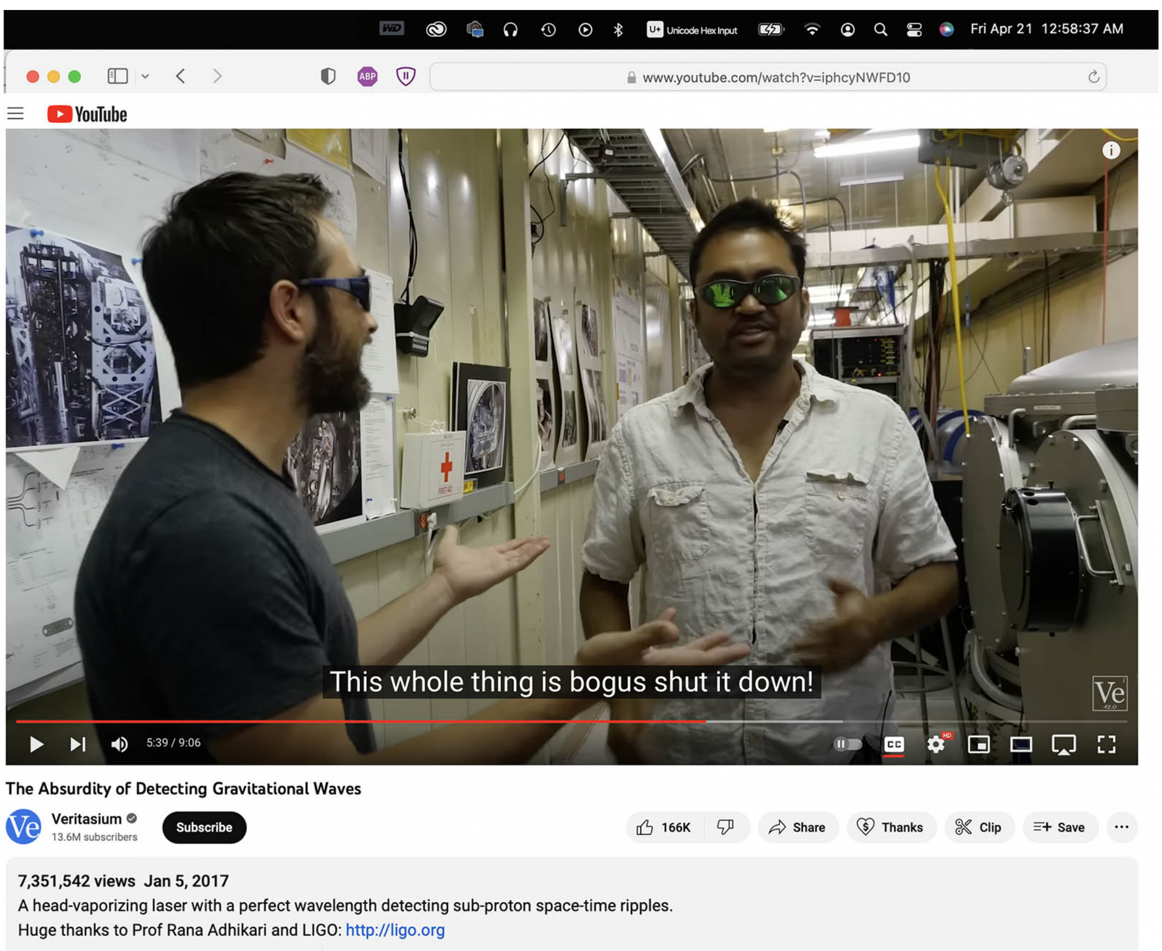


Fig. 34. **Physicists Derek Muller and Rana Adhikari Enjoy a Billion Dollar Joke:** In a passageway of a Caltech laser laboratory, tech-whiz Adhikari awkwardly tries to explain away the Rubber Ruler Puzzle. Not impressive. Stupid, really. [Time stamp ▶ 05:39]. [79]

parallel **Schizoverse** kicks in, light waves miraculously revert back to fantasy flat Minkowski mode. It's ridiculous. Adhikari's incoherent ramble defies a sensible picture — which is presumably why he doesn't draw one.

Contradicting Kip Thorne's account, Adhikari admits: "The light which is in there, it actually does get stretched." Saulson and Adhikari nevertheless contend that, at some point during the passing of a G-Wave, this stops being true. With magical abruptness "new fresh" light remains unstretched (or uncompressed) so that it takes more (or less) time to traverse a longer (or shorter) tube. Of the stretched light they say: "That part doesn't do the measurement for us. But now that the space is stretched, that laser light is like come and gone. It's out of the picture. The new fresh light now goes through there and has to travel a bigger distance than the light before." But *the distance is not* ***measurably*** *bigger.* A G-Wave affected ruler indicates that the length of the arm (its *proper* length) never changes. The G-Wave stretches (or squeezes) the *whole* apparatus — light, space, matter — the *whole* time its passing through. "New light" is not exempt from the effect of the G-Wave. Space rippled by a G-Wave cannot distinguish "new light" from "old light." *Duh!*

The only light that does *not* get stretched (or squeezed) is that which enters the interferometer *before or after* the passage of the G-Wave. To say that the stretched light "doesn't do the measurement for us" is unphysical wishful thinking. LIGOists desperately need the stretched light to get "*out of the picture*," because stretched light *makes the round-trip in the same time as when there is no G-Wave*, because ***"it looks the same if it got stretched or not stretched."*** Actually, stretched light does the measurement perfectly well: it yields a null result, as expected on the basis of sensible physics.

Fig. 35. **Fake Rolex Anyone?:** After explaining it again, Adhikari comes to the same conclusion as before. [Time stamp ▶ 05:56.] [79]

Appearing to have no regard for physical logic, Adhikari claims that light beams that yield a null signal (light in the arms during the passage of the G-Wave) ***must*** be "flushed out of the picture" by "new fresh" light beams that give us the result we want. We ***must*** get the result we want. We ***must*** maintain the façade of being able to see G-Waves. At least we ***must*** be able to "explain" why surreptitiously injected signals should be mistaken for real signals. It's now *easier to get away with a flakey explanation* because the claims of observation have been blessed by so many experts, including the Nobel Committee.

The "explanation" verbalized by Andersen, Saulson, Hunt, Adhikari, *et al* is pure nonsense. Adhikari *admits* that "It doesn't make any sense," and Muller *agrees* with him: "It doesn't!" If the G-Waves are real, then *everything* gets stretched *continuously*. The *old light* vs. *new light* dichotomy is a paragon of "trumpery flummery." That two-bit fake Rolex they paid a billion dollars for will ***NEVER*** be a real Rolex. How agonizing, how night-sweat inducing it must be to contemplate facing the intolerable embarrassment of such a "**giant mistake.**"

Adhikari said it *twice*: "***It doesn't make any sense!***" He makes light of his own assessment, and then defends the company line. The most convincing evidence that we should take Adhikari's initial assessment seriously — that the company line ***really*** doesn't make any sense — is that G-Wavists cannot draw a spacetime diagram of G-Waves traveling through their laser-beamed interferometer without making it obvious that the waves are actually *not observable*. If it takes place at all, the stretching and squeezing predicted by GR is *only abstractly calculable — i.e.,* ***mental*** *— not physically measurable*. Much more likely than that LIGOists have actually observed G-Waves, is that "This whole thing is bogus! Shut it down!"

14. Whodunnit?

Rotonians understand that our critique of G-Wavists' cringeworthy efforts to explain the Rubber Ruler Puzzle is repetitious. The whole of it is important nevertheless, to demonstrate that this is an accurate portrait of the G-Wave community: "new light vs. old light," no sensible spacetime diagram, and contradictions all over the place. It's a twisted maze of dysfunctionality.

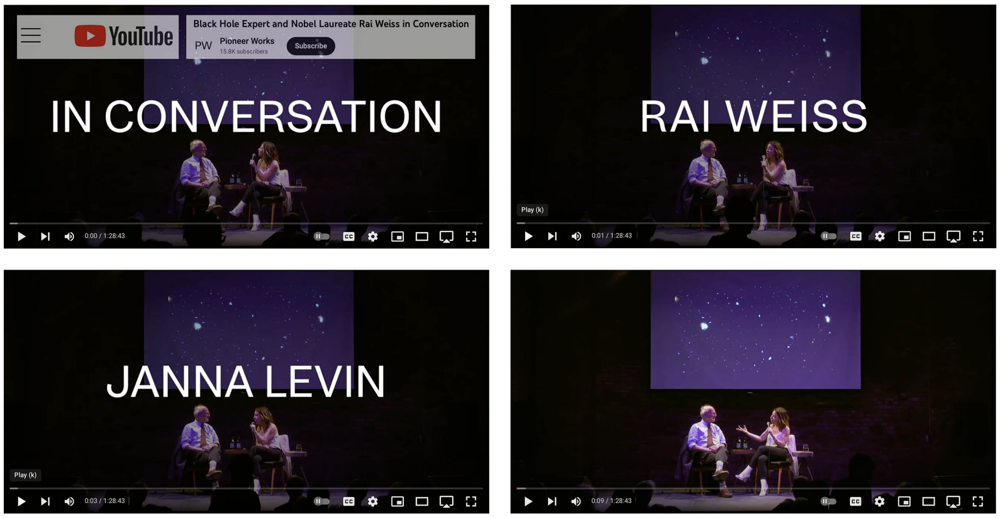


Fig. 36. **LIGO Reminisces:** In 2020 Rainer Weiss and Janna Levin publicly compare notes and memories [80]

We are eager to present the facts surrounding LIGOists' trick that required more ingenuity than a simple injection of fake G-Wave signals: GW170817. A suitable transition to that discussion is found in an on-stage moment when two experts hint at a suspect — a person savvy enough in the workings of LIGO to play an active role in the hoax. On November 12, 2020 Nobel Laureate Rainer Weiss and high-profile black hole expert Janna Levin spoke together at an event sponsored by an organization called *Pioneer Works*. (See Figure 36.) After the predictably fluffy presentation about the marvelousness of LIGO and the heroes of the G-Wave community, comes a question from the audience, as transcribed below.

Audience: [Time stamp ► 1:21:18] How do you know that you're really hearing a gravitational wave?

JL (Janna Levin) : So how do you know it wasn't a false alarm?

RW (Rainer Weiss) : Yeah okay . . . The first worry that we all had, was it a blind injection? . . . It wasn't that . . . The next one was a lot harder. The idea was maybe we've been hacked.

Audience: [Laughter.]

RW : No. I'm serious about that.

As though to suggest that the anticipated account could leave lingering doubts, Levin chimes in:

JL : And you told me you interrogated a handful of people on your own team.

RW : Not only did we interrogate, but much more importantly, there was some reason . . . [interrupted by JL].

JL : I thought it was Rana for a while.

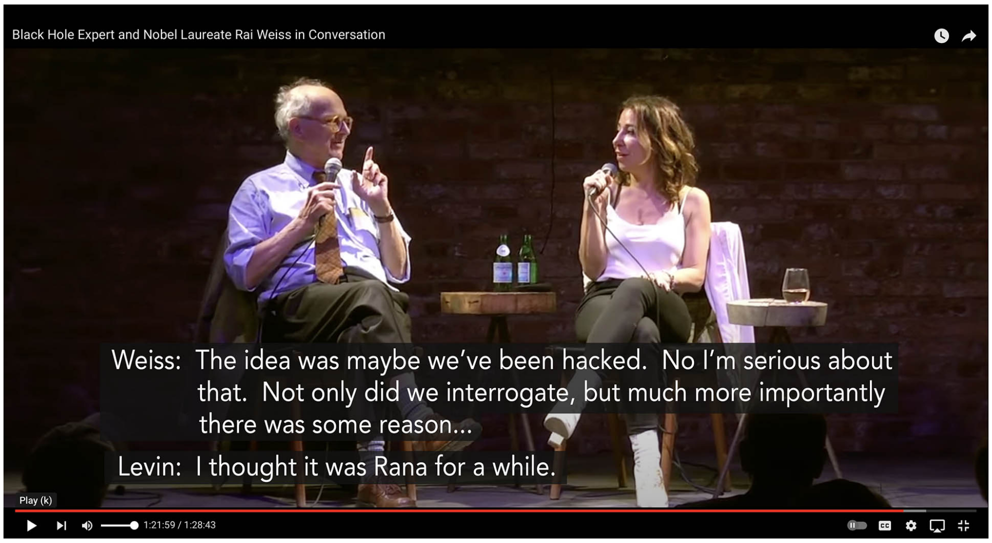


Fig. 37. **Who Could Have Hacked LIGO? :** Rainer Weiss and Janna Levin stumbling upon a suspect? [Time stamp ► 1:21:56.] [80]

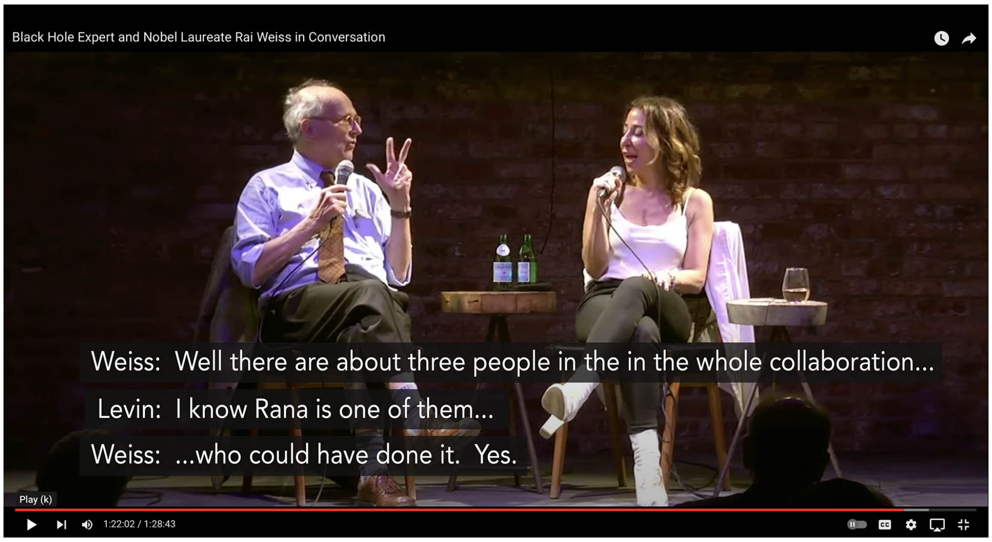


Fig. 38. **Who Could Have Hacked LIGO?:** Rana Adhikari's name comes up. [Time stamp ▶ 1:22:02.] [80]

RW: [Laughs.] Well there are about three people in the whole collaboration . . .

JL: I know Rana is one of them . . .

RW: Who could have done it. Yes. [Time stamp ▶ 1:22:05]

See Figures 37 and 38. For another minute or so, Weiss continued explaining the hacking possibility and what they did about it. Finally, he admitted:

RW: [Time stamp ▶ 1:23:16] Yes, you could still think it was a hacker. Not one, probably two or three hackers. But they get to be so smart each time. We thought about they got smarter and smarter. And they got, they got to know more and more.

JL: Well and now [with the neutron star "observation"] it's impossible. I mean with literally, if you look at the map of satellites around the globe and the telescopes on the Earth that pointed at the neutron stars. And all — you know — detected something coming from the same spot. I think it's completely . . . [indecipherable trail off]

RW: That was different. Yeah. There was no question of hacking.

JL: That's right. There's no question of hacking. I don't think I was completely resolved until that happens.

RW: Oh. That's okay. Well good. I'm glad. [While Levin laughs] You're even a bigger skeptic than I was. But the thing is that that worried us a lot.

The neutron star collision observations referred to by Levin occurred on August 17, 2017 as the gamma ray burst GRB 170817A.

As indicated in Figures 37 and 38 and the dialog to follow, Both Weiss and Levin agree that — though hacking was a possibility for earlier alleged observations — the neutron star binary collision, which presumably caused the gamma ray burst, is also the empirical cause of the alleged G-Wave GW170817. And that this “observation” seemed “impossible” to hack.

The way this event is often reported, “impossible to hack” may seem like a reasonable guess. Nevertheless, after deducing that G-Waves are not observable things, as explained in §1 – §13, our doubts are similar to those of an audience who knows that a magician cannot possibly saw a woman in half and then put her back together, as though she suffered no injury. It’s just a trick. However seemingly improbable, a trick is more likely than the idea that G-Waves have been detected by LIGO. Actual observations in the electromagnetic spectrum are indisputable. But the claim of a coincident “observation” in the G-Wave spectrum, we will argue, is bogus.

15. “Second Revolution” or Night-Sweat-Inducing Hoax on Steroids?

15˙1. *Reitze Lecture*

The common feature of both of these feats of “magic” (re-cohered woman and G-Waves measured by LIGO) is a thunderous, distracting cloud of smoke. After being sawed in half . . . *Taa-Daaa!* emerging through the smoke is the woman who got magically re-cohered, all smiley and chipper! In the case of LIGO, the cloud of smoke was a “glitch” that appeared just as the G-Wave was crescendoing to a chirp in the Livingston, Louisiana interferometer. See Figure 39. Crucial clues bearing on the status of the hoax hypothesis are to be found in the seconds, minutes, hours and days following the initial observation of GRB 170817A by NASA’s Fermi satellite.

In a lecture delivered in the Kavli Auditorum of the National Academy of Science Building in Washington, D.C., on March 28, 2018, LIGO’s CEO David Reitze begins with G-Wave preliminaries

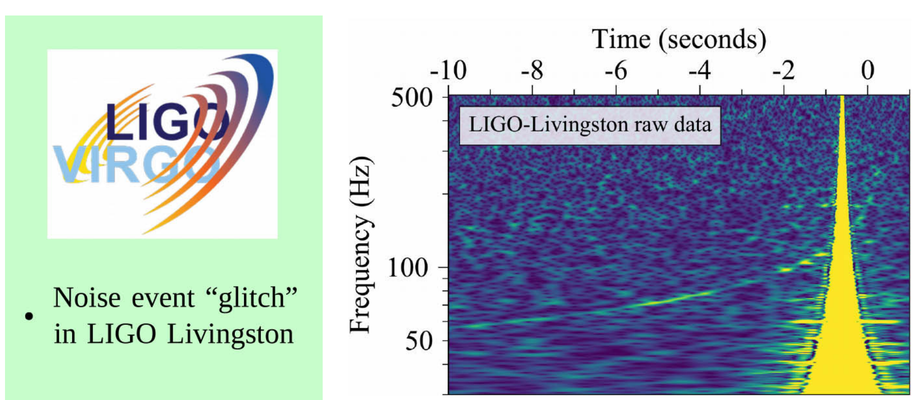


Fig. 39. **Glitch-Adorned Injection?:** LIGO did not automatically initiate a trigger to other observatories because the glitch effectively downgraded their “observation.” In the eyes of the algorithm, it did not qualify as anything other observatories should be interested in, even though human eyes immediately recognize the crosswalks and the motorcycles. Receiving data from the Fermi satellite trigger event (GRB 170817A) enabled LIGO hoaxers to know when to inject their fake G-Wave. They picked a template to be consistent with the *real* gamma ray burst caused, most likely, by the coalescence of a neutron star binary. [81]

sufficient to grasp that, if LIGO's first observations of G-Waves (GW150914) were true, it would represent a *revolutionary* advance in astronomy. Reitze referred to GW150914, more specifically, as G-Wave astronomy's "*First* Revolution." He thus sets up his audience for the unfolding of the "*Second* Revolution," represented by the allegedly joint observation of electromagnetic (EM) radiation and gravitational radiation, nearly simultaneously, from the same source. Reitze does not mention the glitch, even as he admits that the first instrument to report the event was indeed the Fermi Satellite. Reitze also touches on the importance of "localizing" the position of the event on the sky.

In what follows a few quirks of Reitze's oratory have been edited for easier reading. Just before the video's 34:00 minute time stamp, Reitze continues:

> We in the gravitational wave business are still very very poor at this game of localizing. So instead of arc-minutes or arc-seconds, we deal with tens to hundreds of square degrees . . . But we're able to actually do something with this. This is the Second Revolution.
>
> It starts actually not with us, with the gravitational wave community, but with the Fermi Satellite operated by NASA.
>
> They see a burst of gamma rays. As soon as we know that that happens, we look at our data . . . And we see this [Figure 40] :
>
> There's that chirp! And this to us is what we call a gold-plated event. It's immediately obvious that it's some low mass, probably binary neutron star material [undergoing] collision. [82]

Neglecting to mention the glitch-plagued Livingston data is one among other red-flaggable points in Reitze's lecture. Note that his references to the "obvious," "gold-plated" characteristics of

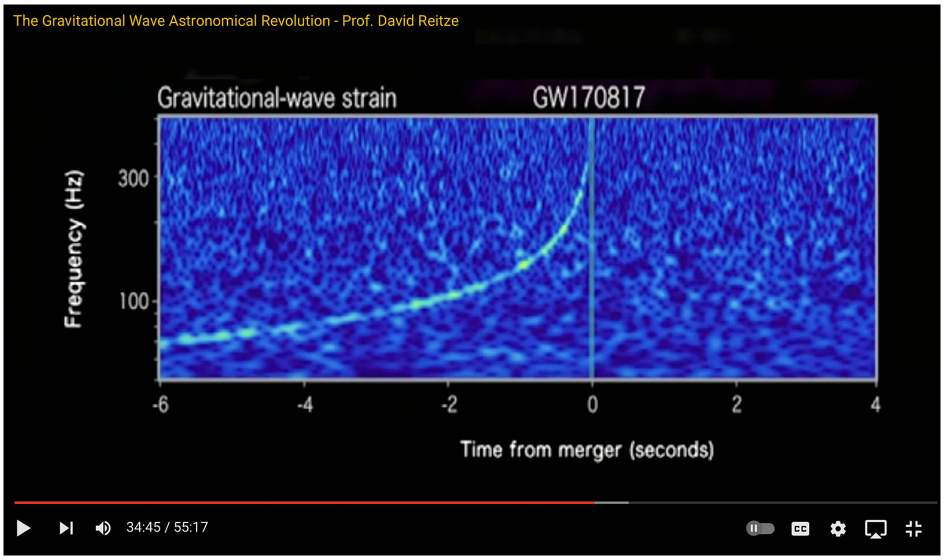


Fig. 40. **Composite Alleged G-Wave "Chirp" of GRB 170817A :** In his lecture Reitze shows the data from Hanford (enhanced to add contrast to the chirp). But he neglects to show the raw data from Livingston, with its conspicuous, trigger-spoiling glitch. [82]

GW170817 are echoes of skeptical responses to GW150914 (two years earlier) because "it looked just too good" (Weiss). Or "This can't be right. Someone did a blind injection and they stupidly just took the most obvious thing that was available" (Pretorius). "Gold-plated" = obviously just too good? Showing his audience only the glitch-free, enhanced graph from Hanford, and projecting as confidently unconcerned about any suspicious facts, Reitze continued with his story:

> And then another satellite, the ESA INTEGRAL satellite, actually sees gamma rays at a slightly different frequency, a little bit higher. Collectively, together at this point we knew very quickly that we were probably in the dawn of multi-messenger astronomy.
>
> It took us about 40 minutes from the time we knew of the Fermi event . . . to look back at our data to make sure that was actually valid data. ***And then we sent out alerts.***
>
> I think overall 70 observatories participate in this. 11 hours after we made our discovery a telescope in Chile — the Swope Telescope — identified that there was a new object in the sky in galaxy NGC 4993 that wasn't there before. [82] [Emphasis added.]

The flurry of intense observation and analysis of the "afterglow" of GRB 170817A persisted for many months (and now years) since the initial burst. It turns out that the object — now referred to as a *kilonova* — is peculiar in various ways. It would surely not have been studied in such depth were it not for its alleged association with a G-Wave. Among the various explicit remarks and implications to this effect in the literature, we find in Philippe Dai-Quang Nguyen's PhD Thesis the echo: "GRB 170817 was orders of magnitude less energetic than most short GRBs, so it likely would

Discovery of the Optical Counterpart of GW170817 with DEC AM

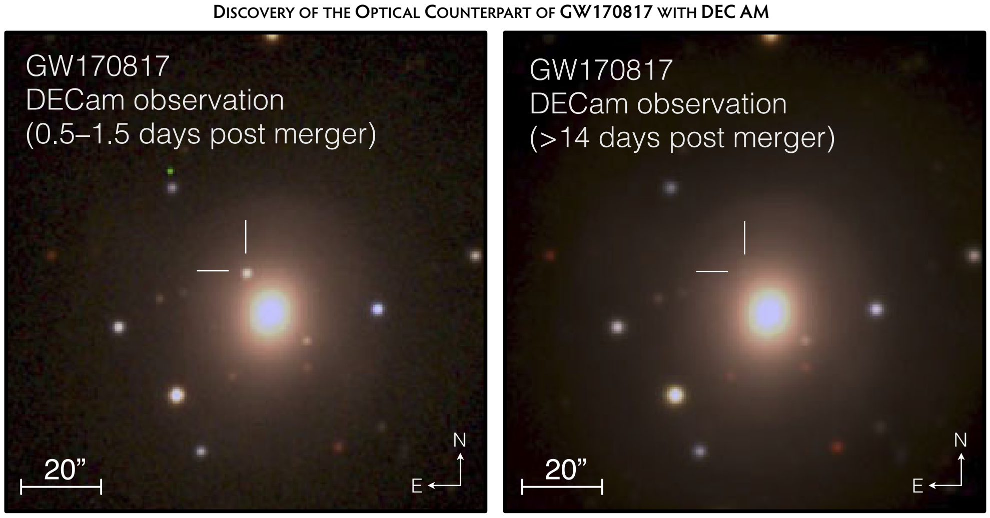


Figure 1. NGC 4998 *grz* color composites (1.5′ x 1.5′). Left: Composite of detection images, including the discovery *z* image taken on 2017 August 18, 00:05:23 UT and the *g* and *r* images taken 1 day later. The optical counterpart of GW170817 is at R.A. / Dec = 197.450374 / −12.381495. Right: The same area two weeks later.

Fig. 41. **GRB 170817A Located at the Outskirts of Galaxy NGC 4993:** The transient nature of the source is established by its fading to unobservability (Right) in most frequency bands two weeks after its clearly visible state about one day following the burst in gamma rays (Left). [83] Not shown here, but in an article describing the work of Stefano Valenti, *et al*, is an image of the last detection — also showing no source object at the indicated location — only a few weeks *before* the burst (July 27, 2017). [84]

have been ignored in the absence of a G-Wave coincidence." [85] GRB 170817A could have easily escaped notice by all EM observatories except Fermi and INTEGRAL, where it may have remained a barely significant entry in their growing catalog of GRB events. Figures 41 – 43 illustrate some of these facts and characteristics.

15˙2. *Tangled Web: Glitch Navigation*

As a final remark, our estimates make GRB 170817A an extremely lucky event.

Alberto Colombo, et al : (Italian Physicists) : But not ***Impossible*** ? [86]

Professional magicians are known for keeping their tricks secret. Rare are those members of the general public who know the exact mechanism of the sawn woman deception. Even more obscure are the exact facts of the G-Wave "observation" hoax — especially GW170817, which is purported to be the *gravitational* radiation counterpart for the *electromagnetic* radiation that was actually observed.

In Presto-Chango theatrical magic acts everybody knows the purpose of the thunderous cloud of smoke: to hide and distract. So too, Rotonians suppose, is the purpose of the Livingston glitch, so remarkably located smack dab on the upswing of the chirp. It should be noted that glitches are a known recurring problem in the G-Wave business. Admittedly, we are not 100% certain that the glitch in Figure 39 was surreptitiously added to the alleged chirp signal. It is either an unfortunate coincidence or an element of a devious plot. All we presently have to decide are ***clues***. The most important clues are those that instill confidence — by physical logic and common sense — that G-Waves are actually not observable. GW170817 must therefore have been *manufactured*, however real and natural GRB 170817A certainly is.

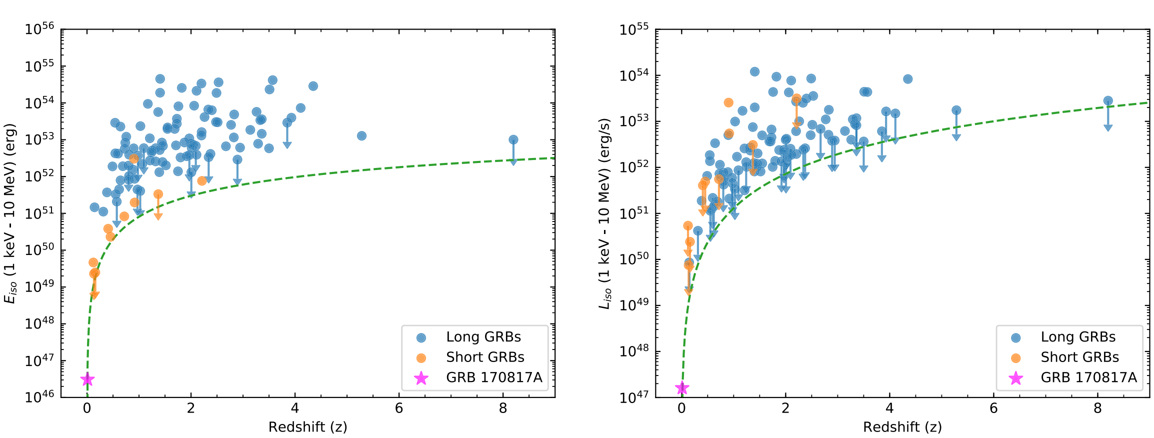


Figure 4. GRB170817A is a dim outlier in the distribution of E_{ISO} and L_{ISO}, shown as a function of redshift for all GBM-detected GRBs with measured redshifts … The green curve demonstrates how the (approximate) GBM detection threshold varies as a function of redshift.

Fig. 42. **Red Stars Indicate the "Dim Outlier" — GRB 170817A :** Assuming that the association with the "host galaxy" NGC 4993 is accurate, the redshift of GRB 170817A is much lower than that of other GRBs. Since redshift is correlated with distance, this means the object is much closer than other other GRBs. Some of the oddities of GRB 170817A have sensible explanations. Others are eye-openers, if not head-scratchers. [87]

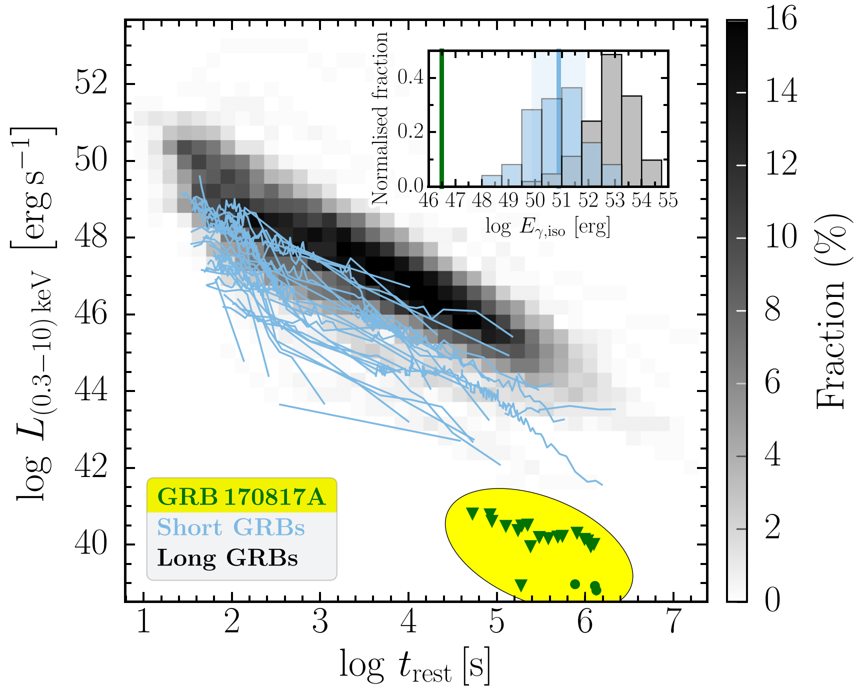


Figure 2. X-ray light curves of GRB afterglows. The parameter space occupied by 402 LGRBs, detected between 2004 December and 2017 September, is indicated by the density plot. Light curves of 31 SGRBs with detected X-ray afterglows are shown in light blue. GRB 170817A lies 2.6 orders of magnitude below the other SGRBs. The inset displays the distribution of energy release at γ-ray energies (SGRBs: blue; LGRBs: gray). The blue vertical line and shaded region indicate the median value and dispersion of the SGRB distribution, respectively.

Fig. 43. **GRB 170817A is an Oddball:** Not fitting in with the crowd, GRB 170817 is special in various ways. Prominent x-ray afterglows commonly go with most GRBs. Not so much GRB 170817A. Some of its peculiarities are chalked up to the likelihood that its emissions are emanating from a conical jet, whose properties are the subject of much theoretical speculation. [88]

In the course of presenting other publicly available clues to support our case, in what follows we will sometimes adopt the point of view of the hoaxer. It is an obviously non-trivial challenge to: 1) Efficiently fabricate data in support of the G-Wave observability hypothesis. And 2) To do so amidst colleagues who are not in on the hoax. For the hoaxer, anticipation, planning, and timing are crucially important. Psychology and sociology are also important factors.

With very fiew exceptions, the scientific community and its audience **Want to Believe.** Untarnished objectivity is extremely rare. The single largest trove of clues has been made available as entries in the often-cited Global Coordinates Network (GCN) "circular." [89] A Table of the key facts from the first 21 entries appears below as Figure 44. In addition, various published papers and lecture presentation slides help to illuminate the case.

The hoaxer's most impressive feat was to predict the smallish (≈ 30 deg^2) area of the sky, within which — 11 hours after the initial trigger — a transient object (kilonova) *aka* SSS17a, AT2017gfo, and other designations, would be found and convincingly identified as the source of the GRB. Knowing that G-Wavists had several years ago made definite predictions for G-Waves produced by coalescing neutron star binaries, the hoaxers had to anticipate a GRB whose physical parameters were within the predicted range. Given the arrival of such a signal, they then needed to buy some time to tinker behind the scenes, to release their "data" that specify the location and other parameters of the source in a plausible enough way to minimize suspicions of foul play.

Rotonians think the glitch should have aroused lots of suspicion, but it was swallowed as plausible by almost everybody, and did indeed serve to buy time. Curiously, even as the salient events took place six years ago, parts of the story did not emerge till years later. For example, the effect of the glitch has been described in a 2023 paper by Mohanty and Chowdhury as follows:

> The GW170817 glitch presents a particularly interesting example of the deleterious effect of glitches on GW searches. The GW signal appeared in both LIGO-Hanford (H1) and LIGO-Livingston (L1) with a combined network signal-to-noise ratio (SNR) of 32.4. Such a strong signal would have been detected easily in coincidence across L1 and H1 by the GW search pipelines in operation at the time. However, a coincident detection was prevented by a large overlapping glitch in L1, causing the release of only an unusual single-detector GW detection alert to the astronomical community. About 4.5 hours elapsed between the initial alert and the release of the first skymap localizing GW170817 obtained by gating the glitch. [90]

Before commenting further on Mohanty and Chowdhury's work, let us reflect momentarily on our challenge as "hoax detectives." On one hand we have access to what has been *claimed* to have happened and various analyses thereof. On the other hand, we suspect this to be only partially true, and are trying with limited information to deduce which parts are in fact true, what is likely being hidden or lied about, and what must have *actually* happened. It is in the interest of not only the hoaxers, but also their unsuspecting colleagues, to give the impression that everything unfolded according to plan, that nothing is the least bit suspicious about any of it.

With this in mind, consider the magenta-colored passage from Mohanty and Chowdhury: "A coincident detection was prevented by a large overlapping glitch in L1, causing the release of only an unusual single-detector alert to the astronomical community." Recall from Reitze's lecture that alerts were sent only after taking 40 minutes to validity-check the data. This 40 minute time window was not, we argue, used to "validate" LIGO data for the chirp time $t_\circ + 0$, because LIGO did not produce any real G-Wave data at all. Instead, the time was used to figure out which template to select, to *plant* a pair of them (one for each detector) so that they nearly coincide in time with GRB 170817A, tweak them so the inferable direction agrees with the Fermi and Integral satellites, and plop a glitch onto the Livingston graph to provide an excuse for why the "detection" did not generate a system-wide trigger.

Note that a key moment within the 40-minute time window occurs closer to 27 minutes after the GRB, as we see in another GCN entry (Figure 45) which is not part of the 215XX series, as partially listed in (Figure 44). The highlighted lines in Figure 45 facilitate determining the duration 13:08:17 – 12:41:04 = 00:27:13. Thus, within 27 minutes of the arrival of the Fermi/Integral trigger signals, the planting and initial tweaking mentioned above must have been carried out, to give the impression that LIGO detected the GRB event, not in EM waves, but in G-Waves. The 215XX series begins about 13 minutes later ($t = t_\circ +$ 40:38) with a roughly specified sky map.

The first entry in the 215XX series, i.e., 21505, refers back to the $t = t_\circ +$ 00:27:13 record shown in Figure 45: "The online CBC pipeline (gstlal) [and its non-public links] has made a preliminary identification." By the account of Mohanty and Chowdhury, and the entry itself, we see that the "GCN/LVC Notice" from 13:08:17 refers to the "single-detector" (Hanford) data that we suppose was inserted — either manually or by a hack computer algorithm — to indicate a detection about two seconds *prior* to the Fermi/Integral gamma ray burst. Because of the glitch, the Hanford data was not coupled with the Livingston data. If the Livingston data had been glitch-free, the combined detections would have initiated a system-wide trigger.

GLOBAL COORDINATES NETWORK: ENTRIES ON GRB 170817A https://gcn.gsfc.nasa.gov/other/G298048.gcn3				
CHRONO-LOGICAL ORDER	GCN #	GMT TIME / TIME AFTER ALLEGED GW CHIRP	INSTITUTION / AUTHOR	SIGNIFICANCE
1	21505	Aug 17 2017 13:21:42 / $t_{\circ}$+ 40:38	LIGO MIT / ESSICK	Report of GW candidate from Fermi's GBM trigger (Time = 12:41:06). Very rough localization.
2	21506	Aug 17 2017 13:47:37 / $t_{\circ}$+ 1:06:33	NASA, LIGO GBM GROUP / CONNAU-GHTON	Refers to GCN 21505 as having "reported a single interferometer LIGO trigger" two seconds before the Fermi GBM trigger. That is not what GCN 21505 actually states, even as these are claims later made more explicitly public. Updates the rough GRB 170817A localization.
3	21507	Aug 17 2017 13:57:47 / $t_{\circ}$+ 1:16:43	ESA INTEGRAL SATELLITE / SAV-CHENKO	Confirms detection of "short and relatively weak gamma ray transient...coincident with GBM." First explicit reference to alleged GW detection time 12:41:04.
4	21508	Aug 17 2017 14:05:11 / $t_{\circ}$+ 1:24:07	ICECUBE NEUTRINO OBS. / COUN-TRYMAN	Neutrino detections within a very wide time window centered on T = 0. Ultimately inconsequential.
5	21509	Aug 17 2017 14:09:25 / $t_{\circ}$+ 1:28:21	LIGO MIT / ESSICK	First mention of "noise artifact" (i.e., glitch) in Livingston data. States that a binary neutron star collision is "clearly visible" in the Hanover data. First rough estimate of the distance of the source.
6	21510	Aug 17 2017 14:38:46 / $t_{\circ}$+ 1:57:42	LIGO NASA GSFC / SINGER	Re-estimate of the source distance, using BAYESTAR algorithm with only glitch-free Hannover data. Promise of improvements with further analysis.
7	21511	Aug 17 2017 14:54:58 / $t_{\circ}$+ 2:13:54	COLUMBIA LIGO ICECUBE / BARTOS	More ultimately inconsequential neutrino data.
	21512			Entry 21512 is missing. Why?
8	21513	Aug 17 2017 17:54:51 / $t_{\circ}$+ 5:13:47	LIGO NASA GSFC / SINGER	Huge improvement in localization estimate attributed to removal of glitch. Sky location centered near R.A. 194°, Dec. −17.85° (middle of skinny ellipses in Figures 49 and 50). Notice the lack of entries for immediately preceding three hours. About five hours has elapsed since initial Fermi trigger.
9	21514	Aug 17 2017 18:16:42 / $t_{\circ}$+ 5:35:38	INDIAN INSTITUE TECHNOLOGY / BHAL-ERAO	Report absence of hard x-ray transients in the window centered on the GBM trigger time, given angular limit of the instrument.
10	21515	Aug 17 2017 18:35:12 / $t_{\circ}$+ 5:54:08	IPN INTEGRAL FERMI / SVINKIN	Joint GBM-INTEGRAL improvement in sky location estimate. Suggestion of forthcoming additional improvements.

Fig. 44. **Table of Initial Entries in Global Coordinates Network Circular G298048:** Note that time entries represent time of *posting*; somewhat later than the time of *observation*. (Continued on next page.) [89]

11	21516	Aug 17 2017 18:55:12 / t_o+ 6:14:08	GLADE Observatory Team / Dlya	Table of galaxies within LIGO/Virgo localization. Explicit purpose of GLADE catalog is as tool for multi-messenger, i.e., G-Wave astronomy.
🚫	21517			Entry 21517 is missing. Why?
12	21518	Aug 17 2017 19:35:28 / t_o+ 6:54:24	Insight HXMT / Liao	First Chinese x-ray telescope. No excess found in predicted area.
13	21519	Aug 17 2017 20:00:07 / t_o+ 7:19:03	Caltech / Kaslival	List of 54 galaxies within the LIGO/Virgo predicted area, proposed to be searched for transients. (Includes NGC 4993, where transient was ultimately found.)
🚫	21520			Entry 21520 is missing. Why?
14	21521	Aug 17 2017 20:12:41 / t_o+ 7:31:37	Caltech / Kaslival	13 more galaxies (face-on) added by same group as in GCN 21519.
15	21522	Aug 17 2017 20:35:31 / t_o+ 7:31:37	Antares Neutrino Obsvtry / Dornic	Neutrino null observation. Ultimately inconsequential
🚫	21523			Entry 21523 is missing. Why?
16	21524	Aug 17 2017 21:34:36 / t_o+ 8:53:32	NASA, GSFC Swift Satellite / Lien	The field of view of the Swift satellite's BAT (Gamma Ray Burst Alert Telescope) did not overlap the LIGO/Virgo prediction area. Report of the expected null observation.
17	21525	Aug 17 2017 22:01:26 / t_o+ 9:20:22	ASDC / Verrechcia	Having only slight overlap with Fermi's GMB localization area, but zero overlap with LIGO/Virgo, the AGILE-MCAL telescope reported a null result.
18	21526	Aug 17 2017 22:22:43 / t_o+ 9:41:39	ASDC / Verrechcia	For reasons stated in GCN 21525, this same group obtains a null result with their GGILE Gamma Ray Imaging Detector (GRID) instrument.
19	21527	Aug 17 2017 23:54:40 / t_o+ 11:13:36	LIGO MIT / Essick	Revised estimation of LIGO/Virgo localization area (centroid slightly lower than earlier prediction).
20	21528	Aug 18 2017 00:36:12 / t_o+ 11:13:08	Fermi GBM / Goldstein	Updated analysis of energy output of the source.
21	21529	Aug 18 2017 1:05:23 / t_o+ 12:24:19	Swope Telescope Las Campanas Obsvtry / Berger	Transient source, SSS17a, identified at R.A. 197.45° / Dec. −23.381°. GMT time of observation given in *Science* article as 23:33 (≈ 10.9 hours after Fermi GBM trigger).

Mohanty and Chowdhury's main concern (in 2023) is to invent ways to quickly and automatically remove glitches, to make the data releases more timely, informative and accurate. In the case of "GW170817 . . . prior subtraction of the loud glitch would have kept the search pipeline from discarding the signal." *Because of the glitch* the "search pipeline" ***discarded*** the signal.

In Marie-Anne Bizouard's LIGO/Virgo presentation from November 2017, it is stated that the *beginning* of the 215XX series (UTC = 13:21) was the "first LIGO-Virgo alert (notice) issued to EM follow-up partners (≈ 80 groups)." [92] This remark is implicitly echoed in Leo P. Singer's glitch

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https://gcn.gsfc.nasa.gov/notices_l/G298048.lvc

//////////////////////////////////////////////////////////////////////////////////////////

TITLE:            GCN/LVC NOTICE
NOTICE_DATE:      Thu 17 Aug 17 13:08:17 UT
NOTICE_TYPE:      LVC Initial Skymap
TRIGGER_NUM:      G298048
TRIGGER_DATE:     17982 TJD;   229 DOY;   2017/08/17 (yyyy/mm/dd)
TRIGGER_TIME:     45664.445710 SOD {12:41:04.445710} UT
SEQUENCE_NUM:     1
GROUP_TYPE:       1 = CBC
SEARCH_TYPE:      0 = undefined
PIPELINE_TYPE:    4 = GSTLAL
FAR:              3.478e-12 [Hz]  (one per 3328022.5 days)
PROB_NS:          1.00 [range is 0.0-1.0]
PROB_REMNANT:     1.00 [range is 0.0-1.0]
TRIGGER_ID:       0x8
MISC:             0x1100001
SKYMAP_URL:       https://gracedb.ligo.org/api/events/G298048/files/bayestar.fits.gz
SKYMAP_BASIC_URL: https://gracedb.ligo.org/apibasic/events/G298048/files/bayestar.fits.gz
EVENT_URL:        https://gracedb.ligo.org/events/G298048
COMMENTS:         LVC Initial Skymap -- a location probability map.
COMMENTS:         This event has been vetted by a human.
COMMENTS:         LIGO-Hanford Observatory contributed to this candidate event.

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Fig. 45. **GCN Trigger Entry *Preceding* the GCN Series Starting at 21505:** Referring to data and non-public links with a "Trigger time" stamp prior to GRB 170817A by about two seconds, and suggesting a G-Wave to be their source — this "trigger," this entry of evidence into the data stream, according to the hoax hypothesis — must have been surreptitiously planted. The raw data must be fake. "This event has been vetted by a human." Rotonians surmise that it was a dishonest human. [91]

presentation slide (Figure 46) in which it is stated: "Chirp visible in Livingston too, but did not trigger due to a photodiode saturation glitch." [93] These remarks confirm Reitze's lecture comment that alerts to EM observatories began only after the key activities taking place in this 40-minute window had ended. The key activities (we suspect) were not to analyze legitimate LIGO-produced data; they were to plant phony data and arrange things to give the impression that the G-Wave signal arrived two seconds before the gamma rays.

Curiously, the glitch is not mentioned in the real-time communication until $t = t_\circ +$ 01:28:21, an hour and a half after the GRB. In the same entry, 21509, a rough estimate is given of the *distance* to the source. Another three hours would elapse before the glitch would supposedly be "subtracted" from the signal to facilitate calculating an improved sky location from the data. Notice that the hoaxers' objective is in conflict with the official objective of the LIGO enterprise: Phony reasons for delay, discarded data, and an opportunity to inject fake data vs. timely and accurate data dissemination. Successfully navigating these cross-purposes clearly requires some skill at weaving tangled webs.

As seen in Figures 46–48, the glitch is a visually crisp spike whose presence scarcely affects what lies on either side. Mohanty and Chowdhury thus conclude: "The impact of glitch subtraction on the GW170817 signal or those like it injected into the data, is seen to be negligible." Interpolating across the glitch to patch over the small slice of obscured data would scarcely affect the overall pattern. The effect of doing so "is seen to be negligible," as we may intuitively deduce from the Figures. Which makes one wonder: Why did it take so long (4.5 hours) to remove the glitch — at

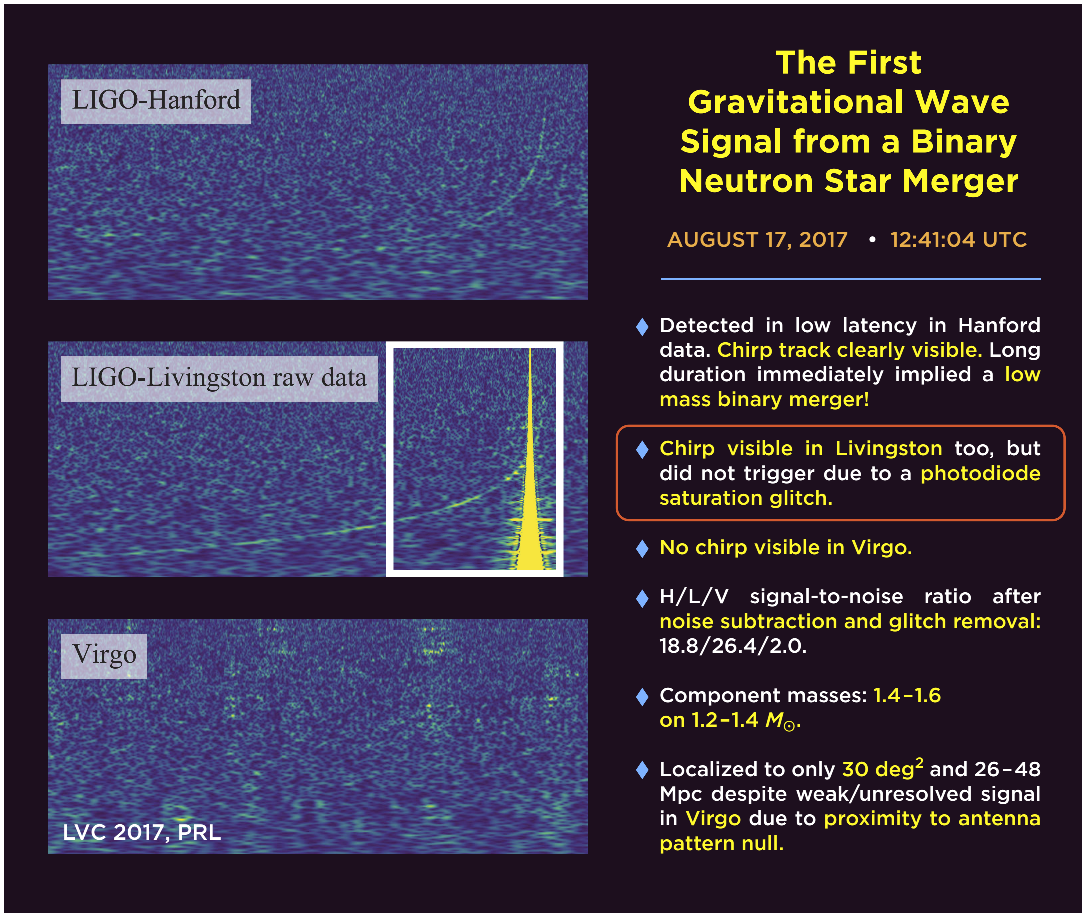


Fig. 46. ***Second Revolution* or Smoke and Mirrors?:** Leo P. Singer's presentation slide explaining the data from three detectors. A gamma ray burst (GRB 170817A) was detected and localized as the object SSS17a (among other designations). Since the detection of G-Waves "doesn't make any sense," the allegation that LIGO-Virgo contributed *bona fide* data to the endeavor doesn't make any sense either. Suspicion is warranted because the glitch appears right on top of the crescendoing chirp. As noted by Singer, the event "did not trigger due to a photodiode saturation glitch." The glitch is a key part of the scam. It bought the hoaxers time and cover to plant false data. There is no ***real*** "multi-messenger" astronomy. So we suspect. [93]

least roughly — to give a more expeditious and informed update to the localization question?

It is intuitively obvious that the chirp line goes in one side of the narrow glitch and comes out the other. Those with graphic arts experience will recognize the Frequency data in Figure 47 as being in pixel format, and the Strain data as being in vector format. Any competent graphic artist would be able to "remove" both representations of the glitch in about 20 minutes. The result would not be rigorously, analytically accurate, but for the purposes at hand, such rigor is obviously not needed.

Presumably, a team at LIGO was tasked with making the rigorous analytical subtraction, which took some time. Once complete, a pivotal following step would be to process the resulting data in LIGO's BAYESTAR skymap (localization) algorithm. Supposedly, this is exactly what happened, and the result is the skinny elliptical area in Figures 49 and 50.

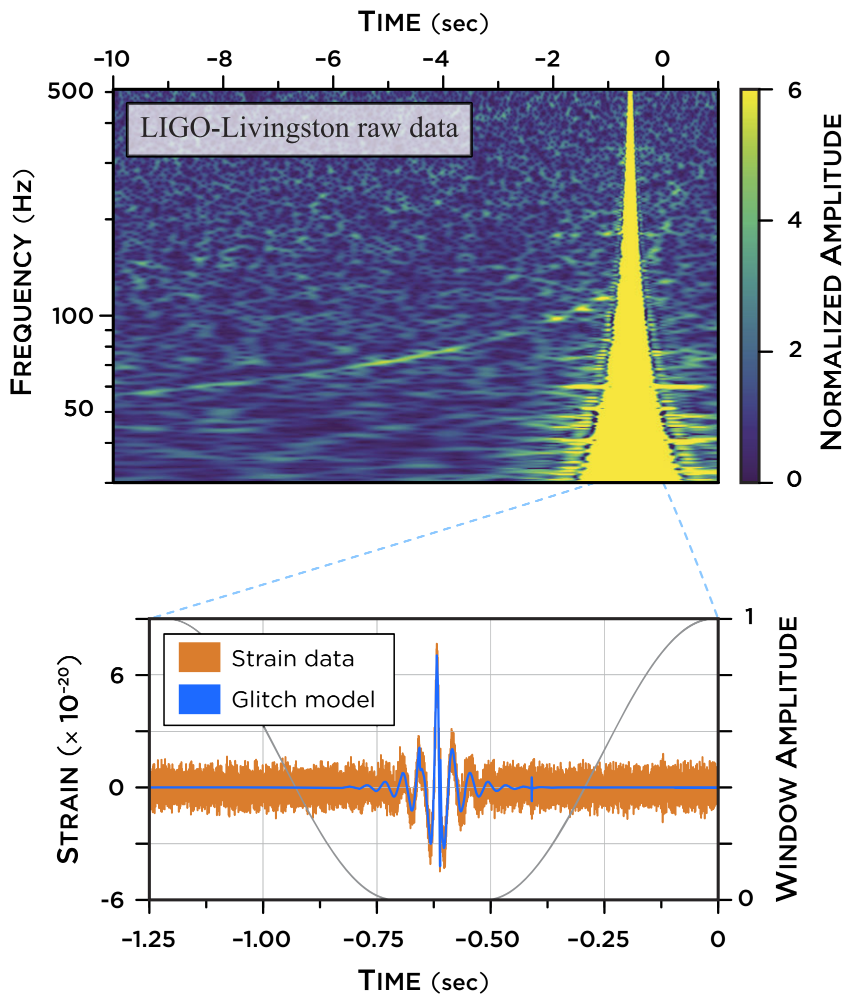


Fig. 47. **Pixel and Vector Graphs:** The LIGO team supposedly spent 4.5 hours subtracting the glitch in order to at last send the data along for processing by the BAYESTAR localization algorithm. This seems like a suspiciously long time to extract the distinct object from the obvious chirp lying below. See also Figures 46 and 48 and discussion in the text. [94]

15·3. *LIGO's Localization Algorithm or Exclusively Electromagnetic Data?*

The alternative scenario (already sprinkled into the above) is that LIGO actually did not produce *any* empirical data of its own. From its store of hundreds of thousands of templates, someone arranged to cue up an appropriate one from the neutron star binary collision category, such as would be expected to correspond to a kilonova-generated gamma ray burst. The template would need to be tweaked so that the (glitch-corrected) "signals" in Hanford and Livingston were slightly different—offset in time, amplitude and phase—from each other. The tweaking would need to be done as quickly as possible, based on the rough (but real) directional information from Fermi and INTEGRAL. The analysis purports that the absence of a signal from Virgo's *null* region also played a role. This suggests that the hoaxers pre-arranged to exclude GRBs from most of the sky, where a positive signal from Virgo would supposedly have been expected. Their strategy is feasible because, as stated on NASA's Hubble Site: "On average, approximately one gamma-ray burst is detected every day." [95] They had to wait for a burst whose particular parameters were within range. Some luck was involved, but statistically, the hoaxers were bound to get their chance, and they appear to have been prepared for it.

In any case, after the first roughly informative entries on the GCN, a few hours would presumably seem not too much to ask to work out the problem of the glitch. Suspicious minds wonder: What was really happening? In those 4.5 hours people at LIGO/Virgo were in communication with dozens of optical astronomical observatories, some of whose instruments and purposes were designed specifically as "wide-field optical transient" locators and measurers. That is, to look for tiny bright spots that did not exist on archival images. Included also, of course were the satellite observatories that triggered the initial search: Fermi and its sister, INTEGRAL.

The hoax hypothesis would have it that this LIGO team (independent of the glitch-subtraction team) was tasked to seek and process all the incoming data from the astronomical community for indicators that would facilitate narrowing the sky area, improving on the initial rough predictions. The result of this communication and processing is the narrow elliptical 30 $\deg^2$ area that LIGO announced in GCN 21513 ($t_\circ$+ 5:13:47) as being the target area for even finer optical inspection. (See Figures 49 and 50.)

Though many key moments in the unfolding saga are succinctly captured in the GCN circular, the chronicle is not always optimally clear or complete. (See Figure 44.) The first entry of the thread is GCN 21505, which reports that the Fermi Satellite's GBM device obtained a trigger-pulling event at GMT = 12:41:06. Then the second entry, GCN 21506, refers to a "single interferometer

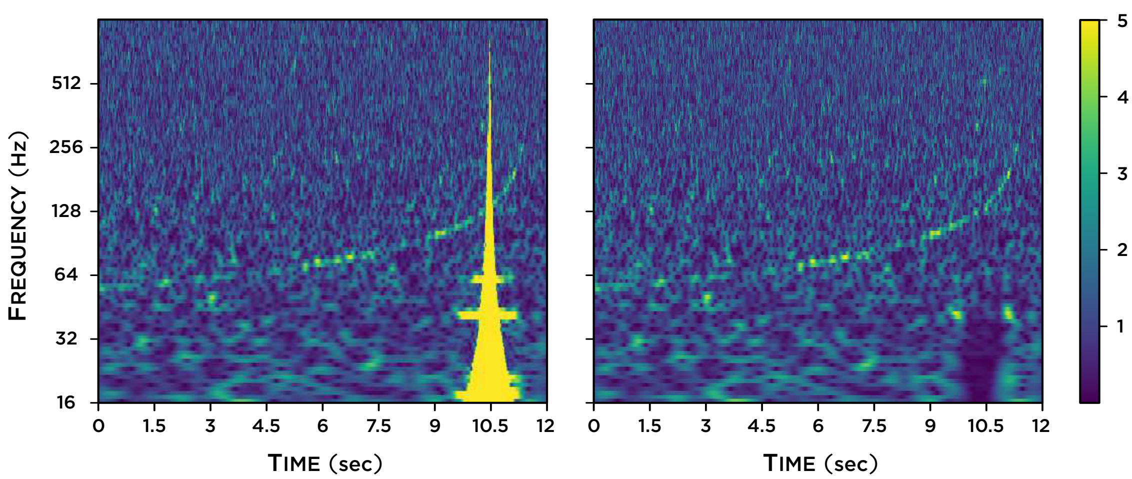


Figure 3. Subtraction of the GW170817 Glitch.

Fig. 48. **Interpolating Across the Glitch:** To this day (six years after GRB 170817A erupted) the alleged milestone "multi-messenger" event and methods for improving glitch-removal techniques are being discussed in the literature. This Figure is borrowed from a recent paper by Mohanty and Chowdhury. [90] The question is, is it reasonable to expect it to take 4.5 hours to get the left side to look like the right side? ***No!*** The time was most likely also spent gathering data to perpetuate the hoax. The glitch was a ruse in a larger plan of deception. Note that the zero of the timeline here differs from the zero adopted by others.

LIGO trigger," as having been reported in GCN 21505, even though GCN 21505 does not explicitly mention a "single interferometer LIGO trigger." As mentioned above, a more complete picture emerges by including the entry shown in Figure 45.

As suggested by the non-public links, the latter "pipeline" is an internal communication system in the LIGO Collaboration. And as indicated by the remark from Bizouard, data uploaded there does not necessarily reach the wider "multi-messenger" astronomy community. As we recall from Mohanty and Chowdhury, because of the glitch, this "data" was evidently routed for *disposal* instead of dissemination. The course of events was orchestrated, we suppose, to give the impression that glitch-plagued and/or single-detector data was innocently "discarded," so as to not clutter the pipeline with useless noise. Cover was thus provided, and time was bought by this diversion, which in turn facilitated faking the GW170817 observation by *planting* fabricated data (both chirp signals, one with and one without a glitch) at $t = 0$ (GMT $= 12:41:04$) in the log. So we suspect.

Rotonians regard as curious—what was non-chalantly stated by David Reitze in his lecture—that it took the LIGO/Virgo team 40 minutes after receiving the alert from Fermi to mention anything at all (GCN21505). Why omit the notice that was also (more narrowly?) disseminated 13 minutes earlier? According to the hoax hypothesis, the corresponding 40-minutes-tardy, G-Wave data *must have been planted* near (two seconds earlier than) the Fermi observation to make it look like their interferometer also "saw" the effect of the neutron star collision at essentially the same time.

Their "single interferometer LIGO trigger" was not disseminated to the wider community because it was single, because the twin apparatus just so happened to be experiencing a nasty glitch

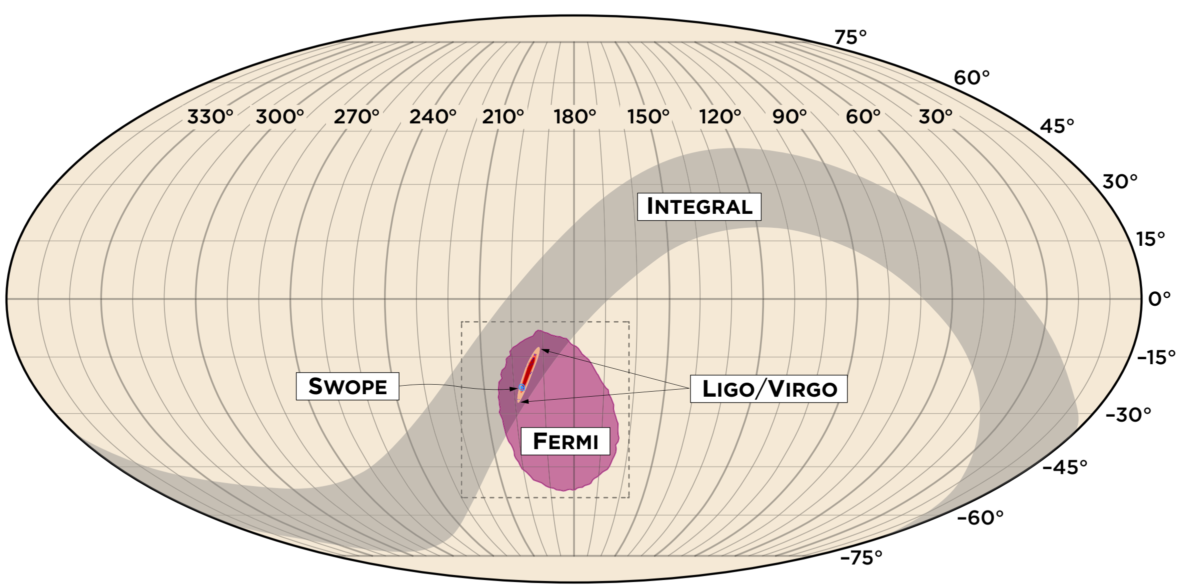


Fig. 49. **Sky Location of GRB 170817A:** Soon after the Fermi satellite Gamma-Ray Burst Monitor's (GBM) initial detection, the INTEGRAL satellite then confirmed the time and rough location. About four hours later the LIGO/Virgo Consortium announced a much narrower localization. About 11 hours after the initial trigger, the Swope Telescope identified a transient object in galaxy NGC 4993, which is ultimately regarded as the home of the neutron star binary that seems to have coalesced with a very energetic outburst. [94,96] (See inset, Figure 50.)

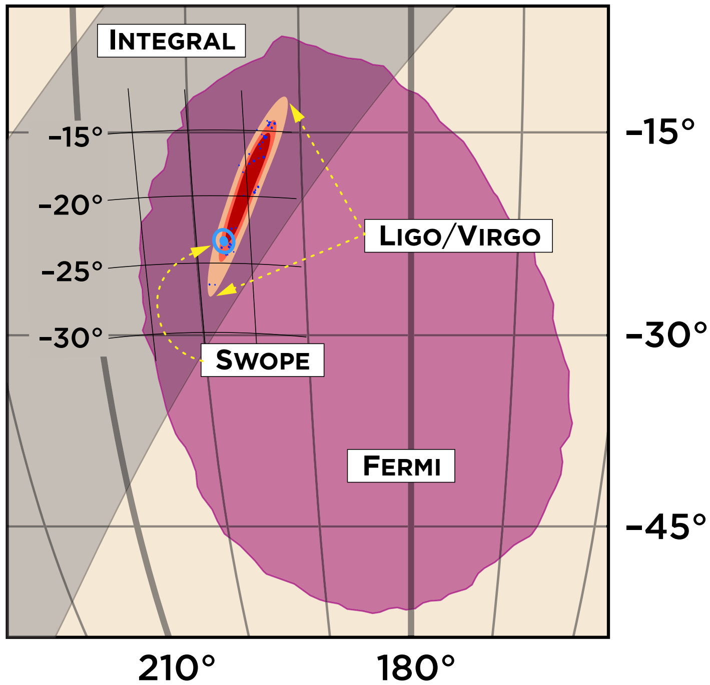


Fig. 50. **Close-up of Sky Location of GRB 170817A:** The Swope Telescope identified the transient object in galaxy NGC 4993 as a result of their concentrated search within the localization area specified by the LIGO/Virgo consortium. How exactly did the LIGO/Virgo consortium come up with their localization guess?

at the key (chirp) moment. As noted above, only 1.5 hours after chirp time is there any mention in the GCN 215XX-series chronicle of the glitch ("noise artifact") in the Livingston interferometer. These are curious facts. One wonders also about the missing entries. The numbers of GCN entries increase in continuous chronological order. Yet the official NASA LIGO link to the circular has no entries at all where we'd expect to find 21512, 21517, 21520 and 21523. What's that about?

Each of these complaints may be due to a rational, innocent cause. In any case, summarized in the Table displayed in Figure 44 are all entries up to the pivotal one by the Swope Telescope team, who at last identified the transient source and its exact location. Two hours into the affair, GCN 21510, based either on data or (more likely) on the template they chose to be consistent with the real GRB data, the LIGOists provide an improved estimate of the *distance* to the source (revised from about 58 Megaparsecs down to about 37 Mpc). Then, aside from an inconsequential neutrino-related entry (21511) the circular goes silent for about three hours. Immediately after the lull, GCN 21513 then suddenly appears as LIGO/Virgo chime in again with a much-improved sky map as generated, reportedly, by their BAYESTAR localization algorithm.

The hoax hypothesis maintains that LIGO/Virgo — in spite of all appearances — generated NO actual scientific data at all. But they are fully stocked with hundreds of thousands of templates and analysis techniques used to backward-engineer any astronomical source — whether real or imagined — to the judiciously chosen injected "signal."

Most noteworthy is that the location prediction for the source of GRB 170817A — made after removal of the glitch (which is what the three-hour wait was supposedly about) — is better than what could be reasonably expected without more real observational data (or a stroke of luck). Therefore, the Rotonians suspect that during the "gitch-removing" lull in the GCN action, the hoaxers took advantage of being in communication with the dozens of other traditional observatories who by now have been anxiously trying to pinpoint the source. Somewhere in this communication was additional data that LIGO/Virgo did not explicitly acknowledge as coming from others, but which was used to tweak their injections to yield what looks like the vastly improved BAYESTAR localization. (Figures 49 and 50.) These data-processing and computerized gadgetry maneuverings must all have been done without any actual G-Wave data.

16. Possible Clues, Leads, and a Rotonian Reminder

16˙1. *Impressive Trick . . . But it Just Can't Be*

We (of Rotonian perspective — see *Digression* below) are looking from the outside in. We don't know exactly how the trick was pulled off, but we just don't buy it. The embarrassingly absurd state of the Rubber Ruler Puzzle means nobody should buy it. Alas, many do. The "trick," to be specific, is the impressively small localization area provided by LIGO/Virgo about halfway between the time of the Fermi/Integral rough localization and the Swope identification of the GRB source. This announcement arrived about 4.5 hours after LIGO/Virgo's first GCN entry (215XX-series). As hoax detectives hoping to uncover more useful clues, or perhaps just leads whose pursuit may be fruitful, we seek things that are out of the ordinary, things that are perhaps just slightly out of place. In the public record there are at least three such things, all of which come from researchers on the Integral Satellite team. We'll address these things after a brief, but perhaps overdue digression. After that, we will inquire as to more recent attempts to make a similar "discovery," i.e., to *repeat* the one and only instance of allegedly "multi-messenger" astronomy.

16˙2. *Digression: Value of the Rotonian Perspective*

Before following through with the plan outlined above, let's revisit an overarching strategy that has been implicitly or explicitly adopted throughout this essay: The ***Rotonian Perspective***.

Our perception of the physical world is inescapably influenced by the fact of having evolved and spent our whole lives on a huge 5.97×10^{24} kg ball of matter. It is probably impossible to overstate the depth and breadth of this influence. It permeates our lives, both in the scientific/technological sense and in the everyday sense. What goes up must come down. Matter is made of static chunks of stuff. The mechanical laws of physics are indifferent to the direction $(+)\,(-)$ of time. Accelerometers may or may not tell the truth about their state of motion. They are schizoid. All motion is "relative."

To the Rotonians these deeply ingrained Earthian assumptions are all nonsense. They are all contradicted by the world view borne of evolving in an environment wherein it is obvious that accelerometers always tell the truth. In the shelter of their twice-Moon-sized cylindrical rotating world, far removed from any astrophysical bodies, Rotonians incessantly accelerate toward the rotation axis. (See Figure 51.) Objects dropped through the "floor" — i.e., the outer wall of their cylinder — fly off on tangents. Objects launched "upwardly" slowly enough to be overtaken once again by the floor (ground) look like parabolas to accelerating, ground-based Rotonians, but actually follow straight-line chords across their world's circular cross section.

Rotonians are acutely aware of the difference between *angular* acceleration and *linear* acceleration. The latter is a product, for example, of the rocket engines they have develped for exploring the space

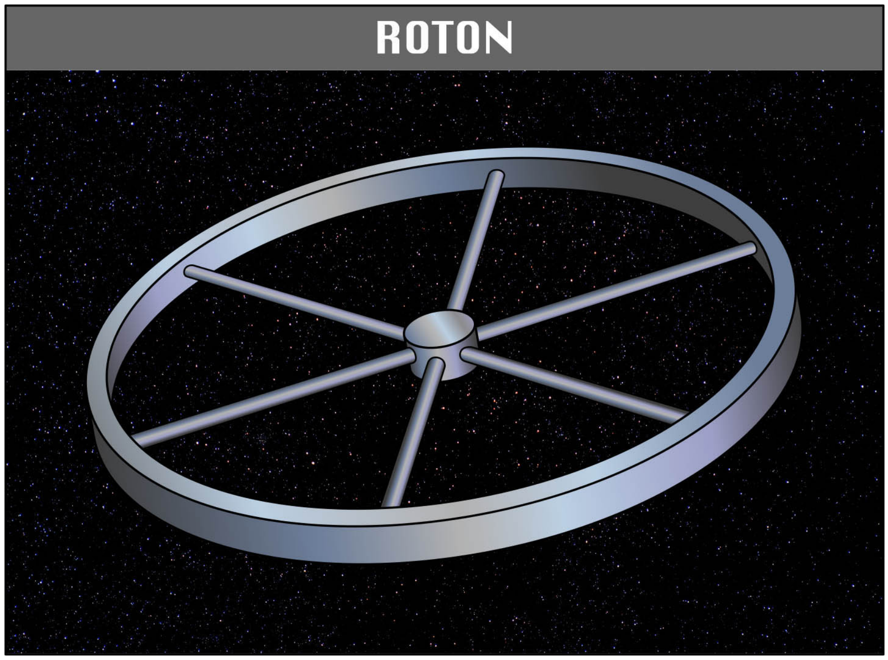


Fig. 51. **Imaginary World of Roton:** Rotonians reside primarily on the inside wall of the outer circumference of the gigantic rotating world of Roton. Having about twice the diameter of Earth's Moon, Roton's rotation period of one hour produces an acceleration the same as that at Earth's surface. We do not concern ourselves with the origins of Roton, nor its means of sustenance. It is an at least *possible* living space. Because of being initially unaware of the acceleration caused by seemingly motionless gravitating matter, the Rotonians' world view, as developed over many thousands or millions of years, would inevitably be — in many key respects — much different from that of humans, who evolved on planet Earth.

beyond the outskirts of their cylinder. Crucially for our purposes, we suppose the mass-to-radius ratio of Roton is too small for its inhabitants to have initially (and for a long time) noticed its gravitational effect on accelerometers.

Oddly enough, this effect goes unnoticed even as the Rotonians' technological prowess grows to the point where they are ready to embark on a long space mission, to at last approach and explore the mysterious faint points of light so far in the distance. Being in stasis for most of the journey, the crew is re-animated by design, by the trigger-event of near-approach to a large body that they only later learn is called a *planet*.

The trigger goes off and the crew re-awaken a little later than the optimal time. Upon looking out the window they are flabbergasted and terrified to discover an enormous orb of matter accelerating straight toward them. Since their rockets are turned off, it is obvious from this fact — which means their accelerometers all give zero readings — (and from radar readings) that the rocket is not accelerating toward the orb. It's the other way around. Radar tracking indicates not only that *the big ball is accelerating*, but that its acceleration is *increasing* in a regular way, according to an inverse-square law. Why?

Having too little time to ponder the reason, it's all the Rotonians can do, in their panic, to turn the ship around and try to accelerate away from the fast-approaching sphere. Happily, in the nick of time they manage a soft landing. Being now pressed upwardly by the sphere's surface, the crew immediately turns to the burning question as to the enormity of the rocket on the sphere's opposite side that surely must exist to keep propelling it. The far-side expedition soon enough discovers and reports: ***There is no far side rocket!***

What could this mean? Having always accepted their accelerometer readings as meaning what they say, as being utterly truthful, and having never encountered such a large concentration of matter before, Rotonians combine these facts to reach the mind-blowing, but seemingly inescapable conclusion that: Matter generates space and propels itself ever outwardly all by itself. That is its essence. ***Matter is an inexhaustible source of perpetual propulsion.*** The process whereby this takes place should perhaps be given the name *gravity*.

Having made these deductions based on the physical facts gathered so far, Rotonians are soon taken aback when encountering and interacting with the native inhabitants, who call their home "Planet" *Earth*. Rotonians quickly learn that Earthians are an accelerometer-schizoid society who claim that "falling" objects (whose accelerometers read zero) are actually accelerating downward. They claim that accelerometers placed on Earth's surface (whose readings are large and positive) are actually "at rest," not moving at all. Earthians couch these claims in terms of their weird conception of ***gravitational attraction***, as it acts across space between bodies of patently static matter. This Earthian theory of gravitation, in its various incarnations, consistently treats bodies of matter as discontinuous, static chunks of stuff. Especially in the incarnation known as General Relativity, the word *acceleration* is sometimes claimed to correspond to *static* bodies and *static* fields. The word *acceleration* is routinely scrambled with the word *rest*. It's crazy.

Rotonians are aghast at, yet tolerant of, the primitive delusions suffered by these poor creatures. In the interest of establishing common ground and resolving differences, they propose to settle at least this one disagreement by consulting *Nature*. It turns out that an experiment proposed centuries ago by the veritable Father of Modern (Earthian) Science, Galilei Galileo, would unequivocally prove, one way or the other, that falling bodies really do accelerate downward or that the planet's matter really does accelerate upward. Matter is either made of static chunks of stuff or it is an inexhaustible source of perpetual propulsion. It's one or the other, and Nature will happily yield the answer in response to the proper implementation of a suitably built ***Small Low-Energy Non-Collider.***

The often well-intentioned but too often boneheaded Earthians are warmed and fuzzied by the Rotonians' adventurous curiosity and friendly spirit. So they figure: "Why not? Let's humor these cute alien Rotonians. Let's cooperate by helping to build their apparatus and doing the experiment (even though we already know the result)." The rest is history. And maybe a Hollywood movie or two.

In recent years I've received the opinion that repeatedly appealing to the Rotonian perspective is annoying and detracting. Though I can understand that response, I think it underestimates the sense of humor of my intended audience. One of the obvious benefits of the literary device is that it sometimes serves to light-heartedly distance me, Richard Benish, from harsh or extreme statements. Blame the Rotonians. Look, that's how they would see it. They really would. Think about it.

Imagine a world in which accelerometers always tell the truth. It's a tall order. I think the Rotonians provide a playful way to dabble with and perhaps eventually adopt this radical, yet physically realistic perspective. Most importantly, the Rotonian view is not just a mind game, or a word game, or an *optional* interpretation of facts. It is absolutely, mortally opposed to the standard Earthian point of view. One of these perspectives is grossly, fatally in error. Happily, the conflict is resolvable by experiment. Galileo's Small Low-Energy Non-Collider experiment needs to be carried out forthwith, so that the matter can be unequivocally settled once and for all.

As noted at the outset, our critique of the G-Wave industry does not depend on the Rotonians' Space Generation Model (SGM) being correct. The offending illogical and contradictory story is borne entirely of a corrupt and confused academic environment, and its theory of preference, i.e., GR. The Rotonian perspective helps, nevertheless to perceive and respect those aspects of GR that ring true, while rejecting those that are questionable, have not been tested, or are sold with test results just don't smell right. The SGM provides, to those who've studied it, confidence to criticize LIGOists because a more rational alternative to GR is readily at hand: An alternative that denies the existence of black holes and GR's other dubious spin-offs, and most importantly survives or dies depending on the result of a simple, relatively inexpensive experiment.

16.3. *GRB Data and the Hoax Hypothesis: Discussion Resumed*

Given what we actually know about GRB's and neutron stars, how likely are we to detect another simultaneous G-Wave/GRB event caused by a neutron star binary collision in the coming months and years? How "lucky" must we be to have been delivered the first and ***only*** alleged instance of "multi-messenger" astrophysics six years ago? If the answer is ***extremely*** *lucky*—as concluded by Colombo, *et al* [86]—then isn't this a good reason to be suspicious?

First on our list of three clues is the following. 1) In a 2021 review paper by Carlo Ferrigno and twenty-one Integral co-authors, origins of the Integral/LIGO-Virgo relationship were spelled out:

> The LIGO and Virgo collaboration launched a call for partners to search for electromagnetic counterparts of gravitational wave events in early 2014 and the Integral team responded swiftly. A memorandum of understanding was signed to be informed in real time of alerts issued by the interferometers, with the constraint of keeping this information confidential. Any possible electromagnetic counterpart was to be shared with the LIGO-Virgo team and the other partners. This agreement [was in effect]... for the second observing run (O2) from November 30, 2016 until

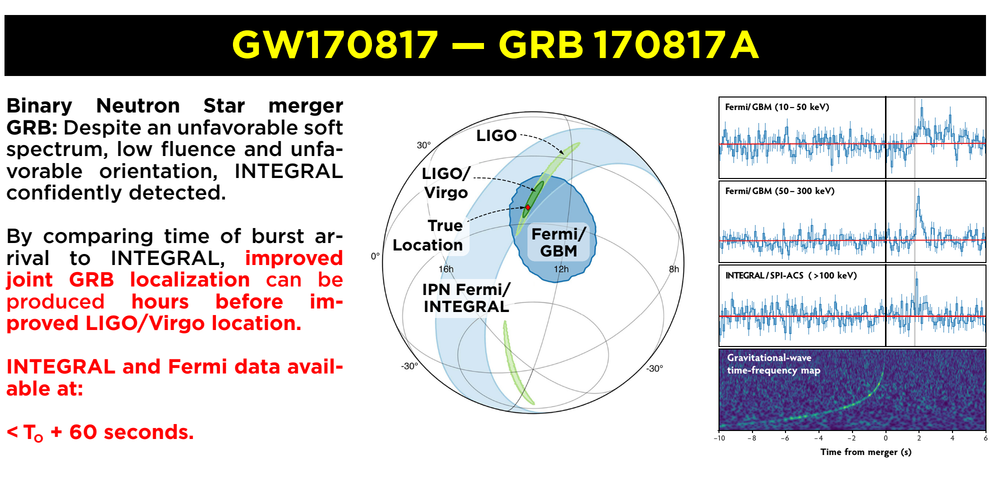


Fig. 52. **Localization Improvements:** In two 2019 lectures by INTEGRAL physicist Volodymyr Savchenko, he presents graphics containing data about the localization of GRB 170817A. [98,99] Elements from the slides are rearranged here to emphasize the claimed quality and promptness of output from Integral and its sister satellite, Fermi. The wording in red is somewhat vague, but seems to allow inferring that the Integral/Fermi performance is on a par with (and quicker than) the performance of LIGO/Virgo.

August 25, 2017. [97]

It is not common for one observatory to publicly provide so much detail about their bureaucratic relationship with another — especially in specifying that it involves a "memorandum of understanding involving the "constraint of "confidentiality." Such a thing may well be appropriate for preventing premature data release to the public. By not specifying the reasons for the memorandum, the authors invite speculation as to behind the scenes information-sharing between the parties. A safe assumption would seem to be that everything flowed harmoniously enough. But we have good reasons to suspect that somewhere behind the scenes something fishy was going on, so we wonder. What else do we find in the public record?

2) As shown in Figure 52, another member of the INTEGRAL team, Volodymyr Savchenko gave two lectures in 2019, wherein it is stated that:

> Improved joint GRB localization can be produced hours before improved LIGO/Virgo localization . . . INTEGRAL and Fermi data available at $< T_\circ + 60$ seconds. [98]

Presumably LIGO/Virgo secured confidentiality-related "memoranda of understanding" from most if not all of their EM observatory partners. That this is the case is supported by a comment in a paper by a team of Italian and Russian physicists who have expressed some doubts about the reporting on GRB 170817A and seem to have sensed an air of secrecy: "Most of the astronomical collaborations are keeping the strict silence on their data and records." [100] In the 4.5 hour interval during which

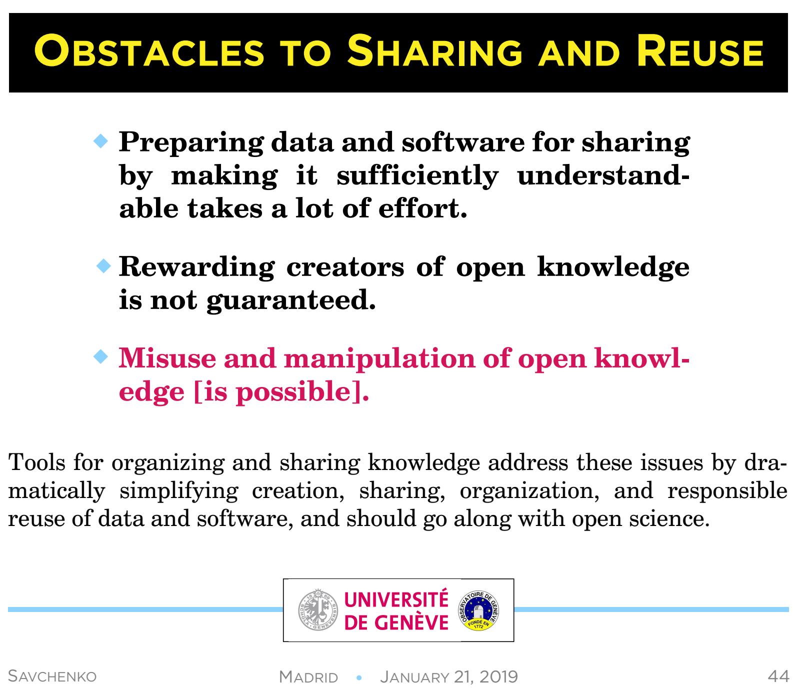


Fig. 53. **Optimizing Data and Information Sharing:** In addition to Volodymyr Savchenko's expertise as an astrophysicist, he is an enthusiastic advocate for improving what we do with our knowledge, concerned with how we gather and go about sharing it. [98]

LIGO/Virgo were taking their time about removing the glitch, might they have also been combing available data from all EM observatories and re-analyzing it? Might this be how the "improved" localization got so much more "improved" than the publicly announced Integral/Fermi result? The LIGO/Virgo team improved their localization data somehow. And we strongly suspect there was no G-Wave data contributing to the effort — none whatsoever.

The two Savchenko lectures in which the above quote (and the content of Figure 52) are found, were delivered within a month of each other, and have the same title: "Elusive Short and Energetic Multi-Messenger Transients." The one from January 2019 (in Madrid) included 50 slides; the one from February (in Geneva) included 22 slides. In both, but more explicitly and comprehensively in the Madrid lecture, Savchenko addressed his concerns about communications and data-sharing. His concluding 8-page section — "Interoperability: Knowledge Transfer and Automation," outlines Savchenko's strategy for improving intercommunications and the state of "Multi-Team, Multi-Messenger and Multi-Disciplinary collaborations."

Savchenko's CV [101] reveals that he had been concerned about these issues prior to his practical engagement with LIGO/Virgo. Thus we have 3) Could it be that Savchenko's experience with the Collaboration alerted him to the depth and details of the problem, to motivate including his data-sharing ideas in presentations that are ostensibly about the astrophysical phenomena ("Energetic Transients") themselves? A slide near the end of Savchenko's presentation identifies particular problem areas and urges their solution, as seen in Figure 53.

16˙4. *Rotonian Action Plan*

The spirit of Savchenko is most admirable. Contrast this with the spirit (tacit, if not explicit) of LIGO/Virgo, with its built-in capacity to cheat, and possibly to hide data behind confidentiality agreements, non-public data links, and internal bureaucracy. In a perfect world we'd have independent-thinking scientists who are not impressed with things like Shawhan's response to the intelligent reader of his *American Scientist* article (Figure 13, p. 27) nor with Feynman's absurd sticky bead argument, nor with Thorne's 2002 fluffy, ambiguous lecture to his students (nor his 1973 wiggly diagram of trumpery flummery). Rational physicists will not be impressed with John A. Wheeler's plungerial showmanship, Adhikhari and Saulson's flakey *new light vs. old light* "explanation" of the Rubber Ruler Puzzle, nor with David Reitze's slick pronouncements of success. In a perfect world Rainer Weiss's "interrogation" of his LIGO team and his remnants of skepticism would have evolved to a much more thorough investigation into the behind-the-scenes communication activities of all of his colleagues and superiors. The abundant and suspicious absurdities of G-Wave "physics" should not have gone on so long unchecked.

Enlightening as such a comprehensive rethink would be, much more important than exposing the details of any hoax or corruption would be to facilitate the ultimate reveal: To at last build and operate humanity's first Small Low-Energy Non-Collider. If the result of Galileo's as yet undone experiment is as the Rotonians predict, this would expose the hypocrisy, if not cultish malfeasance, of not only the G-Wave entertainment industry, but of "relativistic physics" as a whole. Rotonians predict that the test object in Galileo's experiment does not oscillate. After first appearing to fall toward the center, the test object then appears to slow down and asymptotically approach the center. For this simple case the equation for radius with resect to time is approximately:

$$r \approx R\left\{ \operatorname{sech}\left(\sqrt{\frac{4\pi G\rho}{3}}\, t \right) \right\}, \tag{5}$$

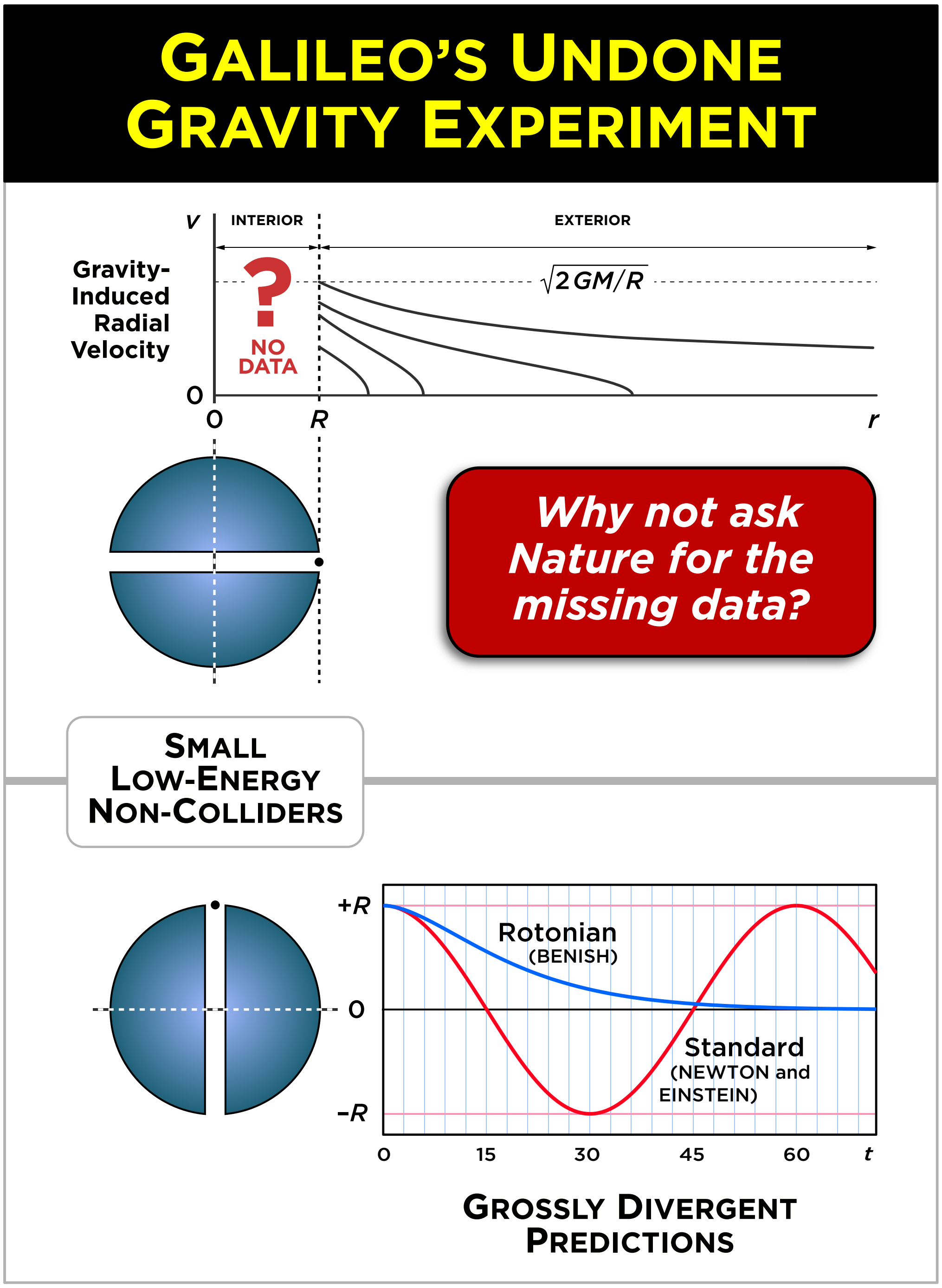


Fig. 54. **Galileo's Small Low-Energy Non-Collider Experiment:** If accelerometers are schizoid liars, then the motion of the test object will correspond to the cosine curve in the lower graph. If accelerometers tell the truth, then the Rotonian's Space Generation Model prediction will be confirmed.

where ρ is the density (idealized as uniform) of the spherical source mass of radius R. (See Figure 54.) This prediction is based on the proposition and the evidence that accelerometers always tell the truth about their state of motion, which implies that matter is an inexhaustible source of perpetual propulsion.

If this result is confirmed by experiment, then trying to make GR (or any theory) agree with Newtonian gravity as a first approximation would be exposed as an irrelevant, delusional pursuit, and the cause of much damage and delay in the advancement of science. ***NO** model of gravity has yet been simply tested in the most ponderous half of the gravitational Universe. We have not yet probed, in effect, right under our feet, right in front of our eyes; we have not yet witnessed gravity-induced radial motion through the center — **INSIDE** every body of matter.* By this negligence we have kept the spirit of the veritable *Father of Modern Science* waiting far too long. Instead of perpetuating the charade of feigned knowledge, we are way overdue to get the answer directly from Nature. The experiment that Galileo proposed in 1632 needs to at last be carried out.

17. How Often Should We See Simultaneous G-Wave / GRB Events?

The urgency of the above plea to do Galileo's experiment is warranted by — among many other reasons — the common sense view that in ***science*** "extreme luck" ought not to be accompanied by thunderous clouds of smoke, curiously placed glitches and other suspicious facts. ***Repeatability*** of scientific discoveries is clearly at issue. After six years, we still have no repeat observation like GW170817–GRB 170817A. It remains the ***only*** allegedly "known" multi-messenger event. LIGO-ists should know better than to deceive themselves and others with overconfidence and wishful thinking.

According to some predictions, by now many more multi-messenger events should have been witnessed. Ironically, by being more consistent with less optimistic predictions, the fact of obtaining only the one isolated case of GW170817 — especially as it was discovered with less sensitive apparatus than what is currently in operation, a few days before the end of Observing Run O2 — stands out as being "extremely lucky." Whether it's that we should be seeing more GW-GRB events; or that we should not have even seen the first one, skepticism is clearly in order.

After six years of tinkering and upgrading — with also the Covid-19 pandemic and other causes of delay to deal with — the latest LIGO/Virgo Collaboration progress report on joint G-Wave / EM-Wave expectations (August 2023) has again delivered nothing:

> We investigate whether there are any coincident GRBs associated with the GWs . . . No counterparts are found.
>
> Not only was . . . the detection of GW170817 . . . the first binary neutron star merger detected, . . . it was also the first, and to date only GW detection with a confirmed electromagnetic (EM) counterpart. [102]

With Observing Run O4 in full swing as I write, the Collaboration continues cranking out G-Wave "observations" alleged to be from "black hole binary" collisions, and a few binary collisions having neutron star signatures, but no other G-Waves with EM-wave counterparts. Why is that?

Published predictions for the expected observational yield span a wide range. In the immediate aftermath of the triumphant "detection" of GW170817, one LIGOist, Edo Berger, waxed exceptionally optimistic. In a *Quanta Magazine* interview from October 2017, he ventured:

> It is clear that the rate of occurrence is somewhat higher than expected. By 2020 I expect at least one to two of these every month. It will be tremendously exciting. [103]

At about that same time, on an undated LIGO Scientific Collaboration web page (whose undisplayed metadata showed a creation date of October 2017) they give the more conservative prediction:

> When the gravitational wave detectors reach their design sensitivity (circa 2020) the expected number of detectable gravitational wave signals rises to between 6 and 120 and the number of joint detections with Fermi GBM to 0.3 to 1.7 per year. [104]

The ”joint detection” number is clearly the more pertinent one.

As noted above, the lower number “explains” why LIGO/Virgo keeps coming up empty. But it fails to explain the amazing good luck of finding GW170817 in the first place, back when the sensitivity of the interferometers was much lower. Whereas the higher number tends to evoke the question (though not as forcefully as Berger’s and other optimistic predictions): Where, after six years of seeking, are all the multi-messenger events? A sampling of other predictions is in order. A graph of a few found in the literature is presented in Figure 55.

Perhaps most curious among the features of these predictions is the possibly overblown optimism in the paper by Chen, *et al* (amongst whose co-authors is Edo Berger). This team projects into the capabilities of future upgrades that will supposedly allow fine-tuning even cosmological parameters such as: the Hubble constant, $H_\circ$, the cosmic matter density parameter, Ω_m , and the

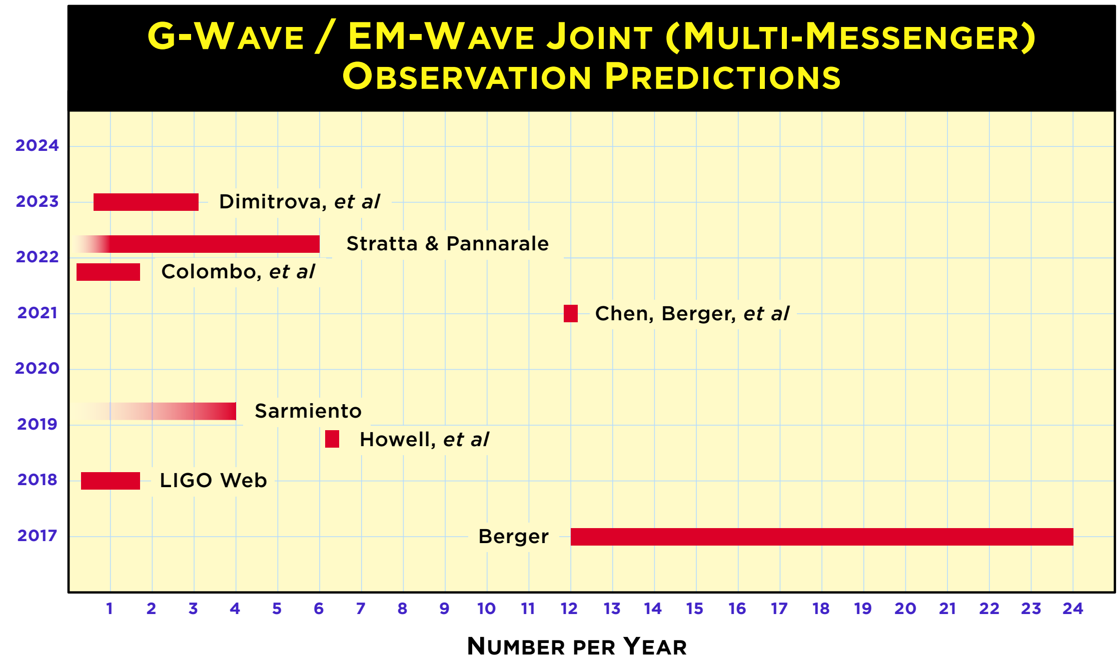


Fig. 55. **Multi-Messenger Predictions:** Following the alleged observation of GW170817 in 2017, predictions for simultaneous G-Waves and EM-Waves from neutron star collisions span a wide range. [103-110]

cosmic equation of state parameter, $w_\circ$. Another very optimisitc LIGO team [111] is working on a plan to facilitate processing the G-Wave data in the minutes immediately *before* the collision, so they can send alerts to EM observatories in time, ideally, to point their telescopes at the location where the fireworks will begin, or would have just started. From the hoax point of view this idea is of course an utterly impossible dream.

We have but one and only one joint "multi-messenger" observation, the one from 2017. From the hoax perspective this is no surprise. The trick is not easy to pull off. It could be done *ONCE*, with the help of a thunderous smoke-cloud *GLITCH*. But invoking that trick again would give the game away. Another glitch smack dab on the upswing of a G-Wave chirp? ***Hah!*** Evidently they've got no more tricks up their sleeves.

So how does the drama play out? A no-oscillation result of Galileo's Small Low-Energy Non-Collider experiment? Short of that scientifically predictable, yet admittedly lofty outcome, others are possible and perhaps more likely. Perhaps a LIGOist who is not in on the hoax will catch wind of what's really happening and bravely spills the beans. Perhaps the hoaxers will give up on the idea of manufacturing another multi-messenger event. They might continue injecting "black hole binary" collision events, but begin diminishing their frequency, tapering down to zero. They do their best to hide their culpability, but resign themselves to the eventual absence of data. Maybe they surrender and confess to the whole caper. Or perhaps they hold out hope because they still believe G-Waves are out there to be detected. Surely with one of the planned upgrades the machine will ***someday*** start detecting real ones?

I don't know. However it plays out, we need to address the indirect evidence that G-Wavists have clutched for decades: The empirical validity of Einstein's quadrupole formula as established, especially, by observations of the Hulse-Taylor binary pulsar.

18. Binary Pulsars, Schwarzschild Exterior Solution, Formation Problems, the Quadrupole Formula and the Convoluted Pathology of G-Waves

> *The ORIGINAL form of the solution of Schwarzschild's problem . . . leaves no room for the science fiction of the black holes.*
>
> S. Antoci and A. Loinger : physicist–translators : Proving the value of original sources. [112]

Although some of its predictions are robust in character and supported by empirical evidence, Einstein's General Theory of Relativity is in many ways notoriously open to interpretation. This is especially true of its conceptual foundations. Recall Okon and Callendar's remark: "There are almost as many Equivalence Principles as there are authors writing on the topic." [60] Recall the fact that a scholarly book about Mach's Principle includes a compiled *Index* of 21 different interpretations. [113] To this day nobody knows what to do about the problem of localizing the *energy* of a gravitational field. And Einstein changed his mind about the existence of G-Waves more than once, as chronicled by Kennefick and others. Other unresolved problems with GR — both conceptual and mathematical — are not hard to find, as discussed in **Part 2**.

The opening quote to this section implies that the famous Schwarzschild solution — as commonly presented in the modern literature — is not the same as the solution that Karl Schwarzchild actually presented in his famous paper of 1916. [114] Various different "Schwarzschild solutions" are indeed to be found, and sometimes debated by a small number of scholars. This tedium is mostly ignored by the majority who have adopted as "*the* Schwarzschild solution," in "*standard* coordinates," an equation that is clearly not the same as Schwarzschild's original. We are concerned about neither the theoretical nor the empirical implications of these debates, because we regard the whole business as quibbling over misguided inconsequentialities. All variants regard spacetime as a static thing that, by its curvature, magically causes test objects located in the field to move.

By contrast, because they regard accelerometers as telling the truth about their state of motion, Rotonians regard the sources of gravity as *being* "sources" because they themselves *MOVE* and generate new space. Bodies undergoing uniform rotation are analogous to gravitating bodies because they both appear to be undergoing *stationary motion*. In the case of rotation, stationary *angular* motion; in the case of gravity, *stationary **outward** motion.* In the case of rotation, it is motion ***through*** space, *through pre-existing space*. Whereas, in the case of gravity, it is the motion and the generation ***OF*** space. The most important consequence of this hypothesis — called the ***Space Generation Model*** — (SGM) is of course the novel prediction for gravity-induced radial motion through the centers of gravitating bodies (Galileo's Small Low-Energy Non-Collider experiment). The experiment is a crucial test of both Newton's and Schwarzschild's *INTERIOR* solution. [115] There are also a few less dramatic, less easily tested differences for exterior situations.

One of these exterior situations is the orbit of binary stars. The standard prediction — which is an approximate, and highly debated solution derived by Einstein in 1918 — is that these orbits should decay: the distance separating the stars gets smaller, as the orbital speed increases. Though the concept of energy and its "localization" in GR is notoriously enigmatic in general, in this particular situation the standard *assumption* is that the decaying orbit corresponds to the emission of G-Waves. In order for the energy of the whole system to remain *conserved*, the energy lost from the orbiting bodies is supposed to be balanced by the energy in the outgoing G-Waves. This is the standard interpretation of the physical significance of Einstein's *quadrupole formula.*

Debates among physicists as to whether this interpretation is correct or not were common both before and after Hulse and Taylor's binary pulsar discovery in 1974. Details of the debate are well-chronicled in Kennefick's 2007 book, *Traveling at the Speed of Thought*. The Nobel Prize-winning discovery provided the first opportunity to test Einstein's formula. As observations continued and improved in the ensuing years, the system's (PSR 1913+16) decaying orbit was found to match the quadrupole formula ever more impressively well. As this empirical agreement persisted and some influential physicists continued promoting the idea that G-Waves should be observable, skepticism about the enterprise tended to be squelched or fade away.

At least two physicists, Fred Cooperstock and Steven Tieu, nevertheless maintained their doubts that the decay also indicates the existence of observable G-Waves. Their alternative hypothesis makes even more sense in light of certain predictions of the SGM concerning astrophysical formation problems. Though perhaps seeming to be unrelated to the issues at hand, these SGM predictions are actually quite relevant. By digressing to explain, we more fully illuminate what connects Galileo's Small Low-Energy Non-Collider experiment to our G-Wave critique in general and more specifically to the binary pulsar observation and the quadrupole formula.

Recall from **Part 2**, that standard astrophysics continues struggling with their galaxy, star, and planet formation models. Especially in the case of stars and planets, the problem is mostly because of the mysterious deficit in angular momentum. The collapsing clouds from which stars and planets are supposed to form have ***orders of magnitude*** greater angular momenta than do the nascent astrophysical bodies birthed therefrom. Succinctly reflecting on this quandary in his book *The Origin of Stars*, astrophysicist Michael D. Smith asks: "Where has the angular momentum gone?" [116] In a review of a book on star formation, astronomer Martin Harwit provides more detail:

> [Stars] form when cold interstellar dust clouds contract and condense into dense, massive ob-

> jects . . . [Upon examining] this hypothesis . . . we immediately encounter three difficulties: (i) The contracting gas clouds must radiate energy in order to continue their contraction; **the potential energy that is liberated in this pre-stellar phase must be observable somehow, but we have yet to detect and identify it**. (ii) The angular momentum that resides in typical interstellar clouds is **many orders of magnitude higher** than the angular momentum we compute for the relatively slowly spinning young stars; **where and how has the protostar shed that angular momentum during contraction?** (iii) Interstellar clouds are permeated by magnetic fields that we believe to be effectively frozen to the contracting gas; as the gas cloud collapses to form a star, the magnetic field lines should be compressed ever closer together, giving rise to enormous magnetic fields, long before the collapse is completed. These fields would resist further collapse, preventing the formation of the expected star; yet we observe no evidence of strong fields, and the **stars do form, apparently unaware of our theoretical difficulties.** [117]

In a more recent commentary on the problem, high-profile astrophysicist and media science personality, Neil deGrasse Tyson laments:

> Not all gas clouds in the Milky Way [or any galaxy] can form stars at all times. More often than not, the cloud is confused about what to do next. Actually, astrophysicists are the confused ones here. We know the cloud wants to collapse under its own weight to make one or more stars. But rotation as well as turbulent motion within the cloud work against that fate. So, too, does the ordinary gas pressure you learned about in high-school chemistry class. Galactic magnetic fields also fight collapse: they penetrate the cloud and latch onto any free-roaming charged particles contained therein, restricting the ways in which the cloud will respond to its self-gravity. The scary part is that **if none of us knew in advance that stars exist, front line research would offer plenty of convincing reasons for why stars could never form.** [118]

Angular momentum conservation is closely related to the energy conservation law. According to the SGM, the result of Galileo's Small Low-Energy Non-Collider experiment would reveal a profound violation of the law. For a perfectly radial trajectory there is of course no angular momentum to lose. But elongated (ellipse-like) orbits within clouds from which stars are born have components of both radial and angular motion. In this case the effect on one inevitably goes with an effect on the other. If the Rotonian non-oscillation prediction is confirmed, then both energy and angular momentum would appear to get lost in the case of a collapsing cloud. This result applies directly to astrophysical formation issues and somewhat less directly to binary star orbits. The pertinent Figure from **Part 2** (§13.7) is re-copied here (as Figure 56). It represents a collapsing cloud, one of whose components, a small body of matter, is schematically shown as a trajectory that orbits amidst many other small bodies so as to ultimately congeal into a star or planet (or even galaxy).

Cloud collapse is a less extreme and more complicated case of gravity-induced radial motion. It is less extreme and more complicated because of the component of *angular* motion. More complicated also because of the non-uniform distribution of source matter (variable density). Recall that the simple case of purely radial motion of one test object inside a larger body (Small Low-Energy Non-Collider) — according to the Rotonians' SGM entails the *appearance* of "lost" energy, as the test object appears to slow down and never pass the center of the source mass. Energy is actually increasing from the inside out, as the source mass and its surrounding space moves incessantly and increasingly outward. Even in the case of a cloud, therefore, because of and the extent to which the component of radial motion is *inside* a cloud-like concentration of matter (however non-uniform the concentration may be) the trajectory will also *appear* to lose energy — which means it will also appear to lose angular momentum.

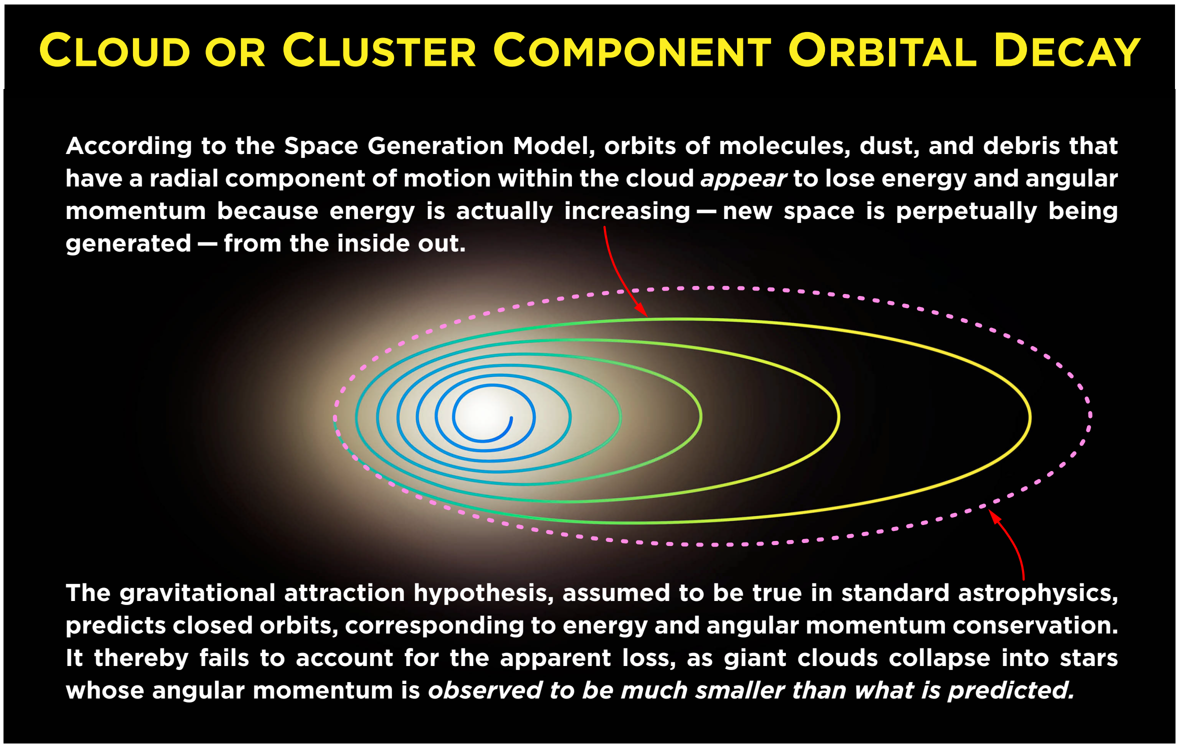


Fig. 56. **Giant Molecular Cloud Orbit Schematic:** If accelerometers tell the truth, then the extent to which the path of a molecule, speck of dust, or other object in a large diffuse cloud has a *radial component*, the orbit will appear to "decay." It will not turn back on itself or otherwise maintain constant total energy. According to standard physics, decaying orbits need to be accompanied by emission of radiation or some other energy transfer, to "conserve" the total. Whereas in the SGM, gravity-induced *radial* motion of a test body *within* a massive body will always *appear* to lose energy without a visible transfer. What is actually happening, as accelerometers incessantly tell us, is that energy keeps *increasing*, from the inside out.

The key point is that the apparent loss of energy of the orbiting body is not compensated by any outward wave or other balancing effect. There is no loss at all. The *appearance* of lost energy is due entirely to the actual gain (increase) of energy from the inside out. Matter is an inexhaustible source of perpetual propulsion. Thanks to this drastic change in perspective, the SGM solves the bulk of astrophysicists' persistent formation problems.

In the case of the binary pulsar, the effect is more subtle because the trajectories of both orbiting bodies are entirely *outside* the other body. Nevertheless, they are each within each other's gravitational field. And the above example serves to illustrate the possibility of an apparent loss of energy that is not "balanced" or conserved in any way. The orbital pattern exhibits decay because energy is not conserved. Accelerometers persistently, ubiquitously scream that energy is not conserved. Energy is incessantly increasing from the inside out.

Now Cooperstock and Tieu do not appeal to any alternative gravity model. They celebrate Einstein's theory and boldly claim that it predicts, or is at least consistent with the idea suggested on the basis of the SGM: that binary star orbits will slowly decay without emitting G-Waves. After expounding on the problematic nature of energy in GR and even the troublesome unintuitiveness of "potential energy" in Newtonian physics, Cooperstock and Tieu appeal to the obscure, but sometimes celebrated work of A. Papapatrou to support their alternative to observable G-Waves:

> While many researchers have been convinced that gravity waves carry energy because of the observed period change of the binary pulsar, there is a more fundamental alternative explanation. [As shown by A. Papapatrou,] over half a century ago, . . . the field equations of General Relativity do not allow the existence of periodic solutions. On this basis, the period-changing binary pulsar is simply manifesting its conformity with the mathematical demands of Einstein's General Relativity rather than the preconceptions regarding energy. [119]

This possibility and the implications of the work of Papapatrou were never satisfactorily addressed by the broader G-Wave community. The "resolution" to the problem was of a purely sociological character. As is often the case in Daniel Kennefick's book — that we quote again at length below — physics and its history are cast in their sociological context. Concerning the energy commonly alleged to be propagated by G-Waves and Cooperstock's doubtfulness as to its detectability, Kennefick writes:

> In the 1990s there have been counterarguments by at least one relativist, the Canadian physicist Fred Cooperstock, that gravitational waves do not carry energy and that there is a flaw in the original Bondi-Feynman thought experiment. Cooperstock and others have even argued that the kind of gravitational wave detectors orignally built by Joe Weber cannot possibly work because of this fault. Nevertheless it appears the hour for debate on this topic has long since passed, and there has been no recent controversy surrounding it. As we shall see, once a critical mass of researchers in a field regard a problem as settled, no amount of effort by a small minority can re-open it, unless in unusual circumstances. [120]

As the book nears its close, Kennefick emphasizes the sociological aspect of the situation, as he returns to describe the fate of G-Wave dissidents including Cooperstock:

> It seems that the **aim** of all the conferences, workshops, papers, reviews, appeals to experiment, and so on, is not to enforce or encourage *agreement* as such, but rather to eliminate or reduce the space for *disagreement*. [Original emphasis.] . . . Whether gravitational waves existed or were emitted by binary star systems, was something that had to be argued out . . . Havas, Rosen, or Cooperstock have received little attention . . . Eventually a critical mass of consensus, enough to close off further debate, formed in favor of the wide applicability of the quadrupole formula . . . Dissent was no longer viewed as healthy or desirable.
>
> The controversial history of this field is interesting precisely because the persistent nature of the debate forced the participants to record their opinions, even if only as rhetorical weapons against each other. It is tempting to view the history of this problem as pathological, . . . as Feynman was inclined to do. [121]

Readers will appreciate the irony of this latter turn in the account, as we regard Feynman as contributing enormously to exactly what makes the problem pathological: Smugness and sloppy thinking. Be that as it may, Kennefick concludes:

> Feynman himself knew very well that scientists are very clever at covering their tracks . . . The fact that the history was controversial, as well as convoluted, gives a rare opportunity to study the tracks. [121]

The ***aim*** of all the work on G-Waves was not to ferret out the truth. No. It was to accumulate a "critical mass of consensus, enough to close off further debate;" to "eliminate or reduce space for disagreement."

How exactly is this not a horror story? Was Kennefick (either semi or fully-consciously) sounding an alarm? If this was not his intent, then what are we to make of it? It is hard to escape the impression that Kennefick senses the political, unscientific — even corrupt behavior of the community. But that community is the veritable hand that feeds him. He therefore feels compelled to tone down his message, to make it palatable to avoid chopping off the source of his sustenance. In other words, we find evidence of "convoluted pathology" compounding itself yet again.

19. Recap : Basics of the SGM Alternative : Epilogue Foreshadowed

> *Once a theoretical idea has been acquired, one does well to hold fast to it until it leads to an untenable conclusion.*
>
> ALBERT EINSTEIN : Sometimes Wise Man : 1950 [122]

19˙1. *Introduction*

Suspicious as the well-placed Livingston glitch and other circumstantial evidence may be, we admit to not having the "smoking gun" ("ironclad") evidence to expose the GW170817 "observation" as a trick. We nevertheless maintain that such evidence *must* exist, because the arguments against the detection of *any* G-Wave are so compelling. The Rubber Ruler/Sticky Bead morass of contradiction and the absence of a coherent spacetime diagram should still be regarded as nails in the coffin of the LIGO hoax.

Agreement of the binary pulsar data with the quadrupole formula — held up for decades as indirect evidence of G-Waves — cannot rescue G-Wavism from the "convoluted pathology" of its tortured history and present state. Cooperstock and Tieu and other critics were arguably correct about decaying orbits being consistent with the non-observation of G-Waves. But their reverence for GR otherwise stands as an obstacle to conceiving a cogent alternative.

Given this sorry state of affairs, we ask: What is it about GR — with its geometric description of spacetime curvature — that facilitated Einstein's derivation of a formula that would be corroborated so many decades later? In other words, what exactly does a material body ***DO*** to warp its surroundings and create the many observable effects of gravity? If we could provide a compelling answer to this virtually never asked question, re-opening the debate should be one of the natural consequences.

19˙2. *Space Generation Model of Gravity; Stationary Outward Motion*

The most prominent clue to the answer to these questions may be found on the nearest accelerometer. Owing to their squishability, our bodies are the nearest accelerometers. The degree to which our undersides are flattened is a measure of our acceleration. Seeing as how there are no rockets producing this acceleration and rotation is obviously also not the cause, we attribute the cause to *matter*. Insofar as a properly calibrated accelerometer says unequivocally that we are accelerating upward (and so too, all around the world) it appears evident that matter is an inexhaustible source of perpetual propulsion. If accelerometers say everything attached to Earth's surface is accelerating upward (as they obviously do) it stands to reason that an *upward* ***velocity*** must also be in the picture.

There is no *single* graphic image that can communicate the concept of gravity as a process of perpetual outward movement. But a *suite* (shall we say) of several images goes a long way toward clarifying the idea. Some of these images are sprinkled throughout this three-part essay and my other work. Presently, a few more Figures will be added (or repeated) for this purpose.

The graph in Figure 57 combines the magnitude with respect to radius curves for what I call ***stationary upward acceleration*** and ***stationary upward velocity***. (The expression is borrowed from three different authorities who used it in connection with uniform rotation: Rindler; Möller; and Landau and Lifshitz. [123-125]) Empirical confirmation for the curves in Figure 57, as they represent the regions *outside* a spherical body, has been amassed over the last several centuries. We have some empirical evidence in support of the *acceleration* curve *inside* the body ($r < R$). But the *velocity* curve — for a path that extends any appreciable fraction of the radial length toward the body's center — has never been tested. *We have no data at all.*

Newton's and Einstein's theories predict that the curve for an object falling from "infinity" continues climbing to a maximum at the center $V_{\text{MAX}} = \sqrt{3GM/R}$, where R is the surface radius. Curiously, for weak fields, the square of this velocity appears in the coefficient (based on the Schwarzschild *interior* solution) for the rate of a clock located at the center:

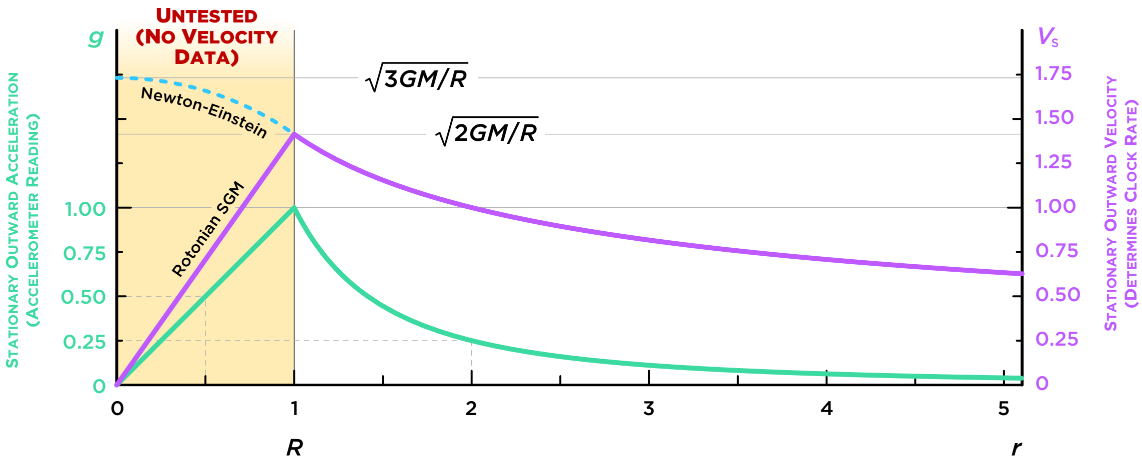


Fig. 57. **Acceleration and Velocity Graphs.:** For a uniformly dense sphere of radius R, the *magnitude* of the acceleration graph (green) is not in dispute. Rotonians think of it as indicating *stationary outward acceleration*. Newton and Einstein think of it as indicating the *acceleration of free fall*. At and over the surface of the sphere $r \geq R$ the velocity graph's magnitude (purple) is also not in dispute. Rotonians think the direction is upward; Newton and Einstein think the direction is downward. Newton's and Einstein's theories regard the massive body as *static*; they regard gravity as magically causing falling objects to move *downward*. On this basis a body falling from infinity into a hole through the center would reach a maximum speed $\sqrt{3GM/R}$ at the center (blue). Einstein expects the rate of a clock resting at the center to be slowed *as though* it were moving with this speed. Accelerometers say the acceleration at finite distances is upward — which strongly implies that, for $r > 0$, the velocity is also upward. But there is no velocity ($V_s = 0$) at the center. Nothing is being forced to move downward. Therefore Rotonians see the body's center as analogous to a rotation axis, whose obvious lack of motion ($V_s = 0$) corresponds to clock rates being a *maximum*. See Figure 58.

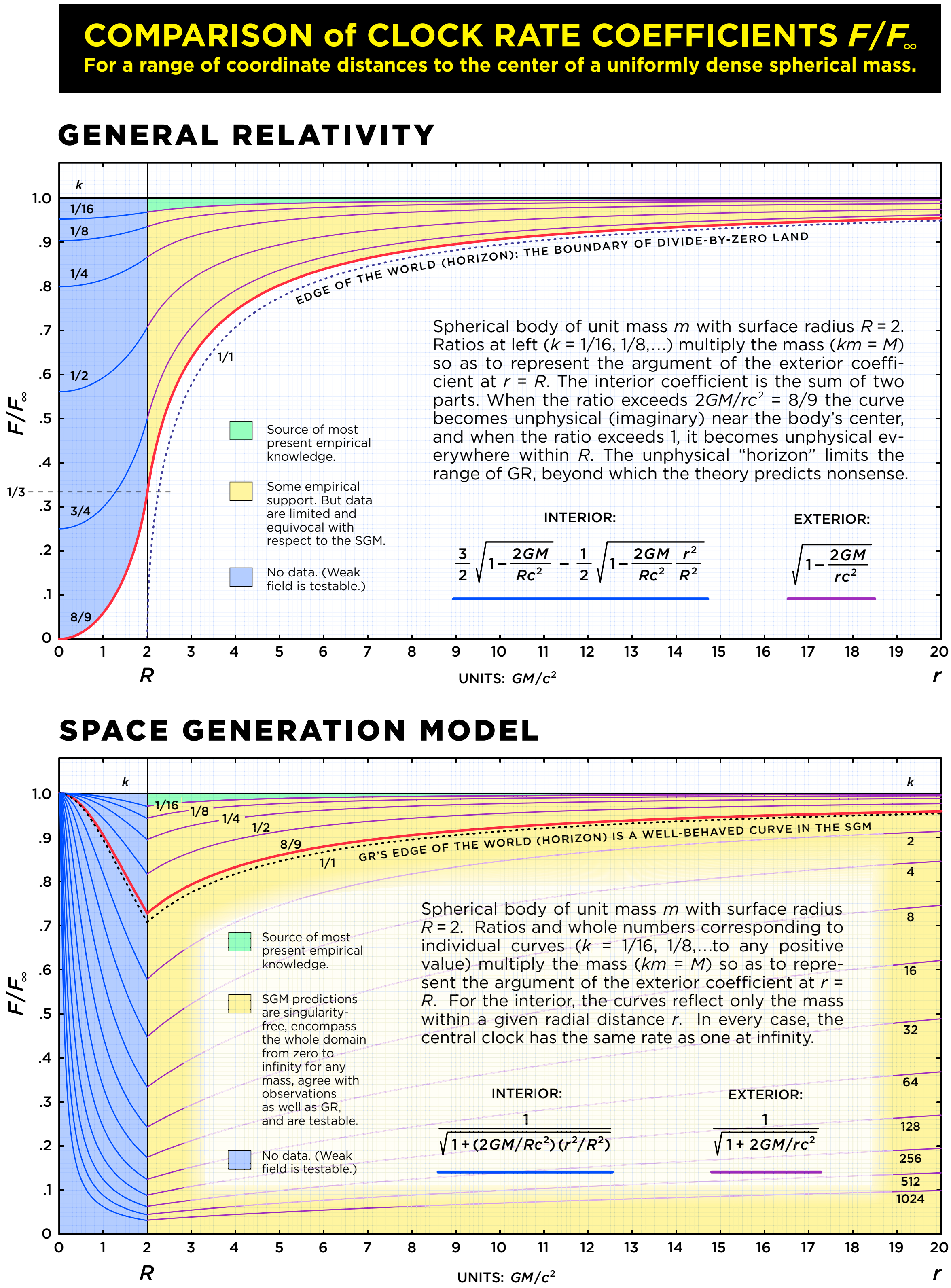


Fig. 58. **Clock Rate Comparison.:** Top: Singularity-ridden GR predicts that clocks stop and densities become infinite when $M/r \geq c^2/2G$. Bottom: Well-behaved SGM accommodates all non-negative M/r ratios. G is Newton's constant and c is the light speed constant.

$$\frac{F_\circ}{F_\infty} \approx \sqrt{1 - \frac{3GM}{Rc^2}} \qquad \text{(weak fields)}. \tag{6}$$

This means that the rate of a clock *sitting motionless* at the center is slowed by the amount expected as though it were *moving* with the speed $\sqrt{3GM/R}$. How can that be? What is the

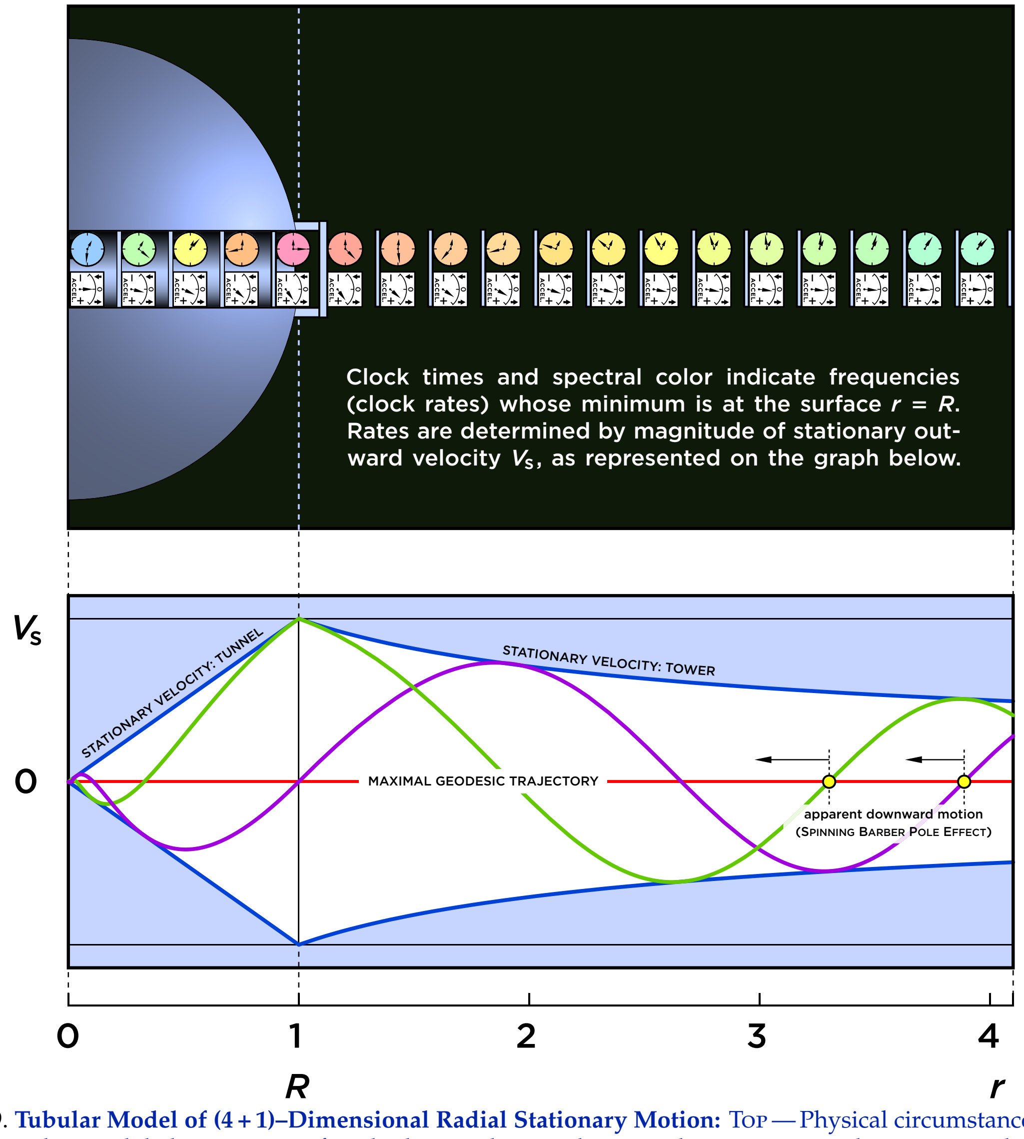


Fig. 59. **Tubular Model of (4 + 1)–Dimensional Radial Stationary Motion:** Top — Physical circumstance represented in the graph below; i.e., a uniformly dense sphere with a tunnel to its center and a tower attached to its surface. Bottom — V_S–axis represents stationary outward velocity; i.e., stationary motion of the system — into or outfrom a fourth spatial dimension. When the cross-sectional graph is conceived as rotating around the r-axis, helices drawn on the tube at 45° to the axis facilitate visualizing the falling motion of *maximal geodesics*: An object falling from infinity maintains the speed of a projected intersection of the axis with one of the rotating curves (like the apparent axial motion of a spinning barber pole). As indicated by the height of the outer envelope, the speed (stationary motion) is a maximum at the body's surface and goes to zero at the center.

physical explanation? There isn't one. Why are Rotonians the only ones to object to this bizarre prediction? From the Earthian perspective, the weird clock rate prediction is accepted without a shrug. Whereas certain predictions of the SGM are instead regarded as bizarre. Go figure!

The most obvious and seemingly fatal objection to the SGM, as described so far, is that it seems to mean everything is getting bigger and bigger, faster and faster, all the time — which is "plainly" not the case. Before answering that objection, let's pursue a bit further the consequences for the rates of clocks. As we see in Figure 57, the diagonal from $V_s = \sqrt{2GM/r}$ at $r = R$ down to $V_s = 0$ at $r = 0$ is in violent conflict with the Newton/Einstein prediction that the exterior curve joins the interior curve upward to $V_s = \sqrt{3GM/R}$ at $r = 0$. For no known *physical* reason, the latter Newton/Einstein prediction means (according to GR) that the rates of clocks decrease to a *minimum* at the center, as given in Eq 6.

Let's think about that. At the sphere's center — as may be accessed by a narrow tunnel spanning a diameter — where the *acceleration* due to gravity is agreed by everybody to go to zero, as the effect from all surrounding matter is canceled by symmetry — the effect on the rate of a clock is supposed to be a maximum. Why? How? What is the surrounding matter ***DOING*** to make the central clock tick slow? To any Rotonian, this makes no sense at all. The closest thing to a state of rest in this picture is that of a clock hovering at the center. Therefore Rotonians suppose its rate should not be the *minimum* given by Eq 6. The rate should be the same as that of a clock at infinity, which is a *maximum*. The expression on the right side of Eq 6 should equal unity. (See Figures 58 and 59.)

The conditions at $r = 0$ for a *gravitating* body are arguably analogous to the conditions at $r = 0$ for a *rotating* body. In both cases the clock rate should be a *maximum*. And this prediction corresponds to the prediction that a test object dropped into the tunnel will not pass the center, but will ultimately appear to move toward the center only asymptotically, in correspondence with the graph at the bottom of Figure 54.

Galileo's Small Low-Energy Non-Collider experiment is therefore not only a test of Newton's and Einstein's predictions for the ***motion of the test object***, but also for Einstein's prediction for the ***rates of clocks***. How can physicists sleep at night knowing that neither of these predictions has been tested, given how feasible, and how inexpensive the experiment would be to carry out? Rhetorical question, of course. The answer is that physicists are happy to ignore physical reality and instead dream about gravitons, multiverses, darkly primeval inflatonic baryon oscillations, and holographic stringbranes. The highest level of consciousness found in the community is that of those who lie awake, cold-sweating the lameness of their alleged "resolution" of the Rubber Ruler Puzzle. Not a pretty picture. A grotesque nightmare, more like it.

19˙3. *Extra Spatial Dimensions*

Now back to the objection concerning the expansive implications of the SGM. The objection can be made more pointed by referring to a consequence of the inverse square law. Suppose we have an array of accelerometers placed at various heights on a huge tower planted on the surface of the sphere, as in Figure 59. At $r = 2R$ the acceleration is 1/4 of its magnitude at $r = R$. How come, with such rapidly varying acceleration, the whole system does not disintegrate? If accelerometers tell the truth, how does the system remain structurally coherent?

One of the beautiful things about the inverse-square law should be mentioned first. The law pertains to any physical process by which something is distributed uniformly from a point source. The something could be light intensity, spray paint or space. In the case of gravity, when the rate of linear acceleration is integrated over the whole spherical surface surrounding the source, at any distance the total is simply the product of the linear rate times the area of the surface. The linear rate decreases as the surface increases by the square of the distance, which means the radial distance drops out of the equation and we get simply:

$$\frac{L^3}{T^2} \rightarrow \frac{m^3}{s^2} = 4\pi GM \qquad \text{(Acceleration of Volume)}, \tag{7}$$

where G is a *positive* constant which quantifies the essential quality of matter as *creator* (generator) of space. In stark contrast, standard physics conceives matter as static chunks of discontinuous stuff, and G is regarded as an essentially *negative* constant. Eq 7 thereby indicates the accelerated *removal* of space ("gravity sucks"). Though rarely conveyed in these terms, it is especially true in Big Bangist cosmology, which posits a primal battle between the space-creating effect of the Biblical Blast and the space-destroying influence of gravity. In recent times the hypothesized Big Crunch (complete removal of all space) victory by gravity has been rendered especially hopeless by invocation of that dastardly doom-ensuring Dark Energy. Rotonians feel sorry for Earth's sheep-like inhabitants who believe and preach as truth such grotesque mythologies. (Apologies to sheep.) A thorough critique and the SGM cosmology — presented as an alternative — are to be found in **Part 2**.

Structural coherence coexists with a range of accelerations for any solid *rotating* body. Acceleration increases with distance from the axis, yet (thanks to the electromagnetic and nuclear forces inside matter) the body remains coherent for all but the most extreme rotation speeds. However obvious it may be, it is important to point out that the gravitational counterpart is only partly analogous. To clarify the relationship we must venture into new (hyper-dimensional) physics. If there were only three spatial dimensions, a range of upward accelerations on our tower (in Figure 59) would indeed be a fatal objection. Structural coherence would indeed be impossible.

As indicated in Figure 59, we suppose not only that the range of accelerations can be coherently accommodated by including a 4th spatial dimension, but that a kind of "hyper-dimensional rotation analogy" facilitates conceiving how it could be so. From basic geometry we see how, upon rotating about a point somewhere along its length, a simple *line* generates and moves into the "next" dimension: a 2D plane — by virtue of this rotation. Similarly, when the *plane* rotates about a line residing in the plane, this process generates and entails motion into the "next" dimension: a 3D volume — by virtue of this rotation.

What happens if we take one more step along this progression? Suppose we now also include time. In common notation we thus contemplate rotation of a material body, i.e., a $(3+1)$-dimensional entity so as to generate a $(4+1)$-dimensional entity. Though much less conducive to easy visualization, one step in this direction is the flaired rotating tube in Figure 59. Happily, this exploration from our familiar world of seemingly $(3+1)$-dimensional spacetime to the expansive world of $(4+1)$-dimensional spacetime facilitates conceiving of the ***necessity*** and the ***cause*** of the ***curvature*** of $(4+1)$-dimensional spacetime.

Going back over our primitive geometrical entities, it is easy to see that if a straight line begins to curve (as an arc) this signals also entry into and generation of a "higher" dimension (2D plane). If the 2D plane begins to curve (as a cylinder), this signals entry into and generation of the next higher dimension (3D volume). One of the key features of this progression is that the manifestation of *curvature* requires the existence of the next higher spatial dimension to ***CURVE INTO***.

Evidence has already been gathered (since Eddington's 1919 eclipse expedition, the precession of Mercuy's perihelion, the Shapiro time delay test, etc.) that, because of gravity, the geometry of our seemingly $(3+1)$-dimensional world is indeed curved. Consistency with the pattern established above strongly implies that $(3+1)$-dimensional curvature ***requires*** a $(4+1)$-dimensional world to curve into. Standard general relativistic wisdom is that a next higher dimension is not needed (see Hobson Lasensby Efstathiou [126]) because $(3+1)$ dimensions are sufficient to give an *address* to all points in spacetime. This *intrinsic* point of view may seem to be sufficient for describing gravitational fields outside a ***static*** body. But it utterly fails to account for what is *causing* the curvature. It utterly fails to explain the *mechanism* of the consequent patterns of motion.

Whereas, by allowing the *extrinsically* conceived fourth spatial dimension and the idea that the whole system is undergoing perpetual outward motion, we see with increasing clarity that our seemingly $(3+1)$-dimensional world is ***curved because of its motion***, its curvature into or outfrom the next higher spatial dimension. We thus seem to be on the threshold of perceiving a kind of hyper-dimensional *rotation*: From $(3+1)$ spacetime dimensions to $(4+1)$ spacetime dimensions — which is facilitated by our new conception of matter and gravity. Another component of our "suite"

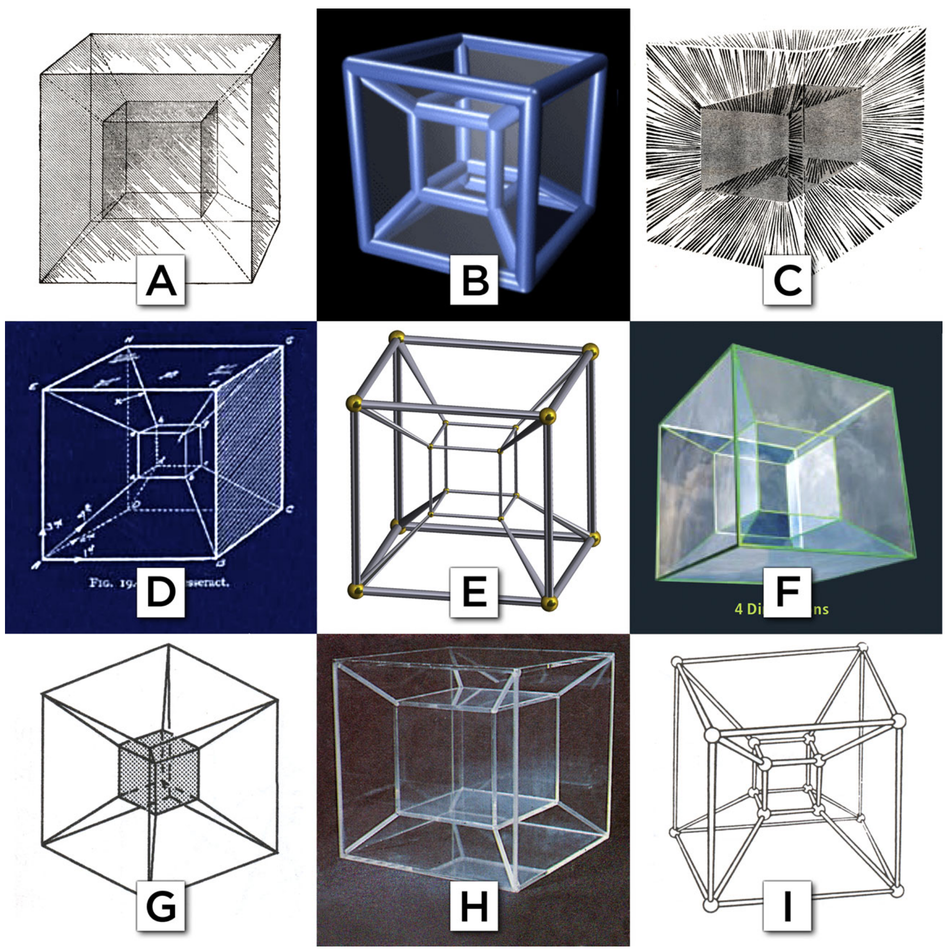


Fig. 60. **Hypercube / Tesseract Gallery:** The geometer Thomas Banchoff has described a tesseract as a *head-on view* or *central projection* of a four-dimensional cube. Motivated entirely by geometrical, as opposed to physical considerations, these images are all supposed to represent an "extra" spatial dimension, which is just as *static* as the first three. I.e., there is no explicit, or even implicit relationship to matter, time, or gravity. Whereas in the SGM, the relationships between the physical elements of matter, time and space entail that no space at all would exist were it not that matter is perpetually generating space by moving, with the unfolding of time, into (or outfrom) the fourth spatial dimension. A) Claude Bragdon [127]; B) Wikipedia [128]; C) Martin Gardner [129]; D) Alexender Horne [130]; E) Victor Schlegel [131]; F) Jan Ambjørn, *et al* [132]; G) Clifford Pickover [133]; H) Carl Sagan [134]; I) Rudy Rucker [135].

of hyperdimensional visual aids is the collage of tesseracts shown in Figure 60.

Turning back to the clock rate comparison graphs (Figure 58) we notice that the SGM coefficient that determines the clock rate $(1 + 2GM/rc^2)^{-1}$ is the *reciprocal* of the coefficient for spatial curvature. Derivation of these coefficients is discussed in my paper, Maximum Force . . . [136] Therein we appeal to the well known equation for the velocity produced by constant proper acceleration:

$$v = \frac{at}{\sqrt{1 + a^2t^2/c^2}}\ , \tag{8}$$

where a is the proper acceleration and t is the time given by a clock in the original inertial system (as discussed in the 2003 paper by George Smoot). [137] We simply substitute the rocket-produced speed (at) with the gravity-produced speed $\sqrt{2GM/r}$, which yields the stationary upward velocity:

$$V_s = \frac{\sqrt{\frac{2GM}{r}}}{\sqrt{1 + \frac{2GM}{rc^2}}} = \sqrt{\frac{2GM}{r + \frac{2GM}{c^2}}}\ . \tag{9}$$

The graphs of both equations asymptotically approach the limiting speed of light, c. In the first case the variable causing the increase is *time*; in the second case the variable is the ratio M/r. When the quantity $2GM/rc^2$ is added to instead of subtracted from unity, we get a pair of coefficients whose intuitively appealing form never entails dividing by zero:

$$\text{Temporal Coefficient}: \left(1 + \frac{2GM}{rc^2}\right)^{-1} \qquad \text{Spatial Coefficient}: \left(1 + \frac{2GM}{rc^2}\right). \tag{10}$$

This result excludes the possibility of black hole singularities. Yet we obtain spacetime curvature that agrees with all observations in the weak-field regime. Since Einstein's derivation of the quadrupole formula was also a weak field approximation, it follows that these new coefficients would yield an almost identical formula for the apparent loss of energy from binary star orbits.

These theoretical features of the SGM surely warrant an empirical test by which either the SGM or GR will be falsified. Clearly the alleged evidence at the margins — in the tiny effects predicted in far off decimal places — is inadequate to decide the matter. To robustly, unequivocally discover which model emerges intact, we need to conduct Galileo's Small Low-Energy Non-Collider experiment. Doing so would yield evidence having the potential to cause a rethink of not just low-order predictions (inside matter) but even the *sign* of gravity at *zeroth* order: perhaps $(+)$ instead of $(-)$.

19.4. *GR's Diverging Coefficients*

Another curious fact about GR raises suspicions and suggests that the SGM is a preferable conceptual construct. Radial falling problems are treated differently as between Newtonian gravity and GR. Specifically, unlike the Newtonian *force* of gravity, in GR force-like effects are instead attributable to differences in the *rates of clocks*. Outside matter, the GR Schwarzschild *exterior* solution predicts that *clock rate* differences correspond to *radial length* differences of equal magnitude. In the Schwarzschild *exterior* solution, the spatial coefficient is everywhere the *reciprocal* of the temporal coefficient. Whereas in the Schwarzschild *interior* solution this is no longer true. Inside matter the magnitude of the spatial coefficient approaches unity at the center. Even though the rates of clocks are supposed to descend to a minimum, there is no corresponding effect on measuring rods. Space at the center is utterly flat. Why this divergence? It is a fact of Einstein's mathematical theory, but there is no conceptual/physical explanation. Over the surface the magnitudes of the corresponding coefficients are reciprocals of each other. (EXTERIOR):

$$\text{(11)} \qquad \text{TIME}: \left(1 - \frac{2GM}{rc^2}\right) \qquad \text{RADIAL DISTANCE}: \left(1 - \frac{2GM}{rc^2}\right)^{-1},$$

where M is the mass, r is the coordinate radius and c is the light speed constant.

The expressions in Eq 12 represent the corresponding coefficients for the Schwarzschild *interior* solution, where M is again the mass of a spherical body, whose density must now be specified as uniform, and R is its surface radius. (INTERIOR):

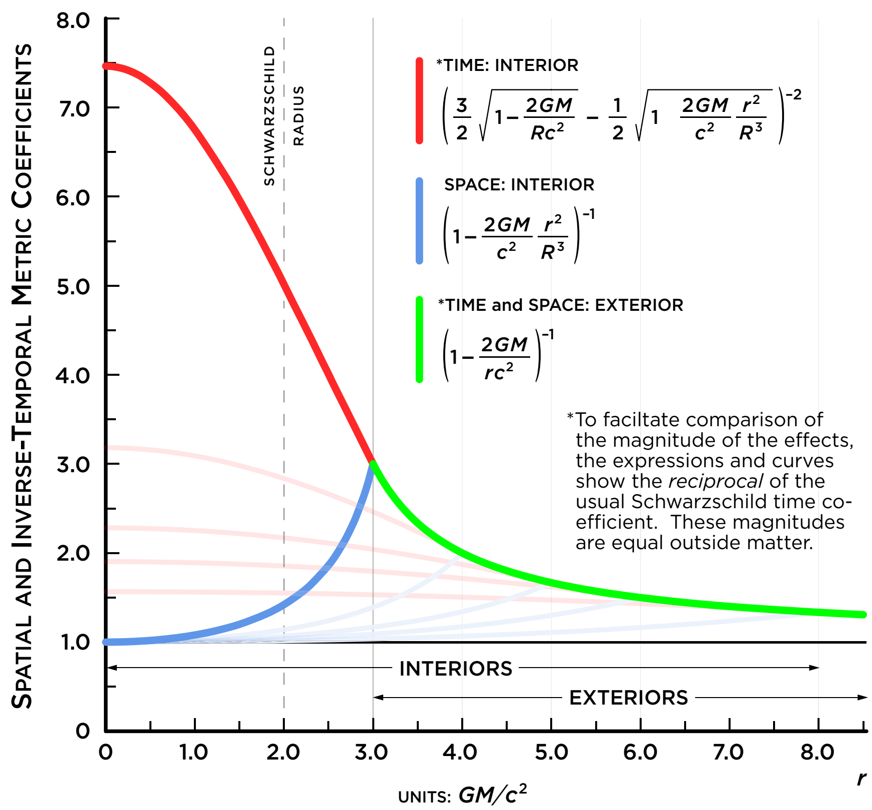


Fig. 61. **GR's Schwarzschild Space and Time Coefficients Diverge at the Surface:** ***Why is that?*** Nobody has ever provided a physically reasonable explanation, because there isn't one. Intuitively, one expects the magnitudes of the effects to be the same. Intuitively, it makes sense that the effect would go to zero (coefficient = unity) at the center. GR's temporal coefficient thus appears as a conspicuous error. ***What does matter DO to make a clock at the center tick slow?*** Nothing, say the Rotonians. The temporal coefficient goes to unity (clock rate is a ***maximum***) at the center, which means an object falling into a hole through the center will never quite get there. This prediction needs to be tested by building humanity's first Small Low-Energy Non-Collider.

$$(12) \qquad \text{TIME}: \quad \left(\frac{3}{2}\sqrt{1-\frac{2\,GM}{Rc^2}}-\frac{1}{2}\sqrt{1-\frac{2\,GM}{c^2}\frac{r^2}{R^3}}\right)^2 \qquad \text{RADIAL DISTANCE}: \quad \left(1-\frac{2\,GM}{c^2}\frac{r^2}{R^3}\right)^{-1}.$$

The Schwarzschild interior solution is not very realistic for astronomical bodies, whose densities tend to rise steeply near their centers. But for spherical bodies whose gravity is very small compared to their other cohering forces, the solution is expected to accurately represent the curvature of spacetime found therein. Figure 61 shows a graph of the expressions in Eq 12 for a few strong-field cases, the most prominent one being $r = 3GM/c^2$.

Clearly indicated by this graph and these expressions is that the reciprocal relationship of Eq 11 no longer holds inside matter. The Schwarzschild *interior* solution predicts that, as the center is approached, the temporal coefficient shrinks further below its flat space value of unity. Whereas the spatial coefficient approaches, and at the center reaches, its flat space value of unity. Note that Figure 61 makes the pattern visually conspicuous by graphing the *reciprocal* of the time coefficient—to make it > 1 instead of < 1. If the magnitudes of the effects on space and time inside matter were the same, the single curve for the exterior would extend as a single curve into the interior; it would not diverge.

Clearly, the symmetry is broken. Why is that? Why should space and time be affected by the *same* magnitude outside matter, but by *different* magnitudes inside matter? The spatial flatness at the center seems intuitive enough, *by symmetry*. But then why doesn't such symmetry-based reasoning apply to clock rates? What does the surrounding matter *do* to disrupt the pattern and continue diminishing (to a central minimum) the rates of interior clocks? Intuitively, it makes more sense that the magnitude of the effects on space and time would not only be everywhere the same (reciprocals of each other) but would also be neutralized at the center (canceled by symmetry).

A non oscillation result for Galileo's Small Low-Energy Non-Collider experiment would prove that Newtonian gravity and Einstein's GR are grossly incorrect, because they regard accelerometers as schizoid liars. There is no such thing as a STATIC gravitational field. Everything moves. All bodies of matter generate space and undergo perpetual outward motion. That's what gravity is.

19˙5. *Time's Arrow*

There are no sacred cows in physics. Laws of physics such as conservation of energy, or whatever, are made to be tested.

Sheldon Lee Glashow : (Physics Nobel Laureate) : [138]

Time keeps on slippin', slippin', slippin', into the future (tick, toc, tick).

Steve Miller Band : [139]

Given creation of matter . . . the other [temporally asymmetrical physical processes] follow inevitably. . . . We can say that if the physical laws are such that matter is created then time's arrow is explained and understood.

Fred Hoyle : (Famous Physicist) : [140]

Time is the most commonly used noun in the English language. The subject of endless domestic squabbles, literary works, and philosophical debates, one of its most important features is that: There are no take-backs. What's done is done. And yet the established mechanical laws of physics (Newtonian, Maxwellian, Quantum Mechanical, or Einsteinian, etc.) are indifferent to the *direction* (+) or (−) of time.

Seeing an egg unscramble itself would therefore not — strictly speaking — violate the mechanical laws of physics. One of the reasons — perhaps the primary reason — for this profoundly fundamental characteristic of physical understanding is the ***energy conservation law***. From the vast literature on the subject, Laura Mersini-Houghton captures the current state of the situation:

> Time — the enigmatic building block of the cosmos — has stubbornly challenged natural philosophers and scientists over millennia. What is time? Why does it have an arrow? Why isn't time's arrow "DNA-ed" into our physical theories? Such basic questions that touch upon one of nature's most fundamental properties remain mysterious.
>
> Scientists continue to wrestle with the enigma of time. Is time a dynamic or a fundamental property of spacetime? Why does it have an arrow pointing from past to future? Why are physical laws time-symmetric in a universe with broken time-reversal symmetry? These questions remain a mystery. [141]

Once again we benefit by considering extreme cases, ones that are vastly less complicated than a scrambled egg. A video of an egg unscrambling itself would of course be easy to arrange. Just play it backwards: Change the usual time forward (+) to time backward (−). But we can tell that the backward option is physically unrealistic, not "true to life," because it just never happens, it seemingly *cannot* happen, in the real world.

Happily, the extreme cases alluded to above are those in which gravity provides simple examples of backward-running videos that look perfectly natural. A small body moving around a large body

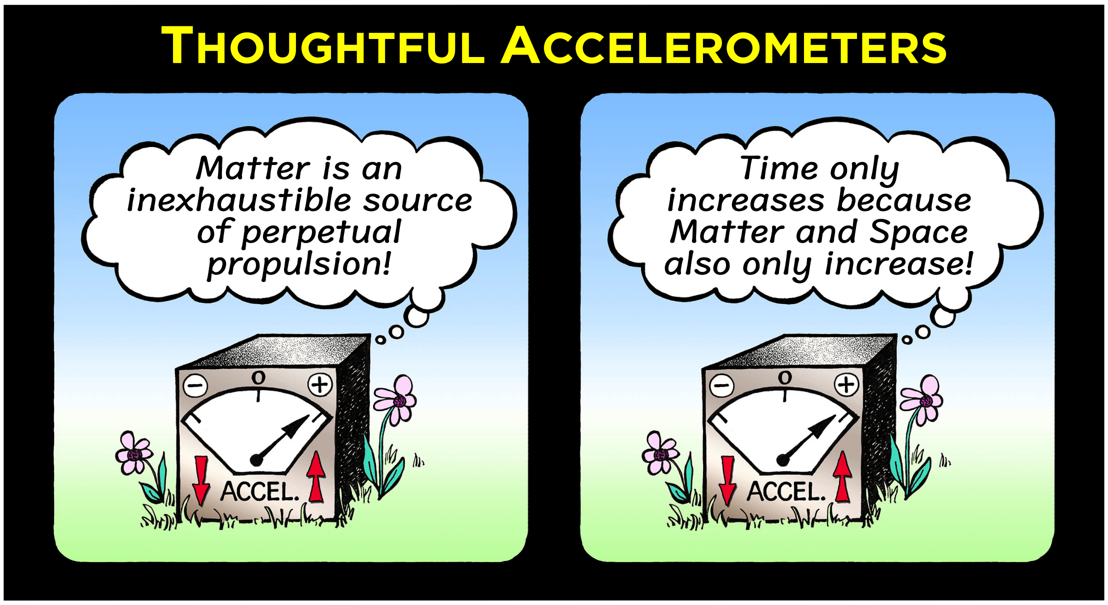
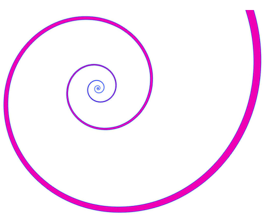


Fig. 62. **Accelerometers Weigh in on the Meaning of Their Data:** ***Matter, Space and Time: Going up!***

in a circular orbit is one example. According to Newton and Einstein, another example would be a test object falling back and forth in a hole through the center of a larger body (Small Low-Energy Non-Collider). As indicated by Figure 54, the graph of this motion is supposed to be a cosine curve. Of the utmost importance is that, unlike the case of a circular orbit, nobody has ever ***observed*** the through-the-center radial oscillation. If the standard prediction is right, then a video would look the same whether played backward or forward. The motion is symmetrical with respect to the direction of time. What if the SGM prediction is right?

If the SGM prediction is right, we would have unequivocal proof that "time's arrow ***IS*** DNA-ed into our physical theories," because Newtonian and Einsteinian conceptions of static matter and static gravity would be trashed and replaced by the perpetually upward SGM. The sech curve is obviously not symmetrical. If this curve — corresponding to the Rotonians' prediction — were to be observed in real life, such that the test object asymptotically approaches the center, then a backward-played video would be recognizable as such. The motion only makes physical sense in the forward direction of time.

In other words, because of the flagrant violation of energy conservation revealed by this simple gravity experiment, the arrow of time would (as Hoyle anticipateed) lose much of its enigmatic status. The laws of physics would require a drastic, comprehensive overhaul. The accelerometers in Figure 62 may be on to something.



20. Epilogue

Singularities . . . are intolerable from the point of view of classical field theory because a singular region represents a break-down of the postulated laws of nature . . . A theory [such as GR] that involves singularities and involves them unavoidably, moreover, ***carries within itself the seeds of its own destruction*** *. . . If you are going overboard and admit serious exceptions to what we consider the conventional behavior of nature, a violation of the energy condition might be swallowed just as much as the occurrence of a singularity . . . The whole situation looks like one in which* ***a completely new idea is required.***

Peter G. Bergmann : Einstein's long-time assistant : Centennial Celebration : March 1979 [Emphasis added.] [142]

What is gravity?. . . What is inertia?. . . Is our much-exalted axiom of the constancy of mass an illusion based on the limited experience of our immediate surroundings?. . . How are we to prove that what we call matter is not an endless stream, constantly renewing itself and pushing forward the boundaries of our universe?

Sir Arthur Schuster : Physicist : 1898 [143]

20˙1. *Concepts of Light and Speed*

> THE PRINCIPLE OF THE ABSOLUTENESS OF THE SPEED OF LIGHT: *Whatever might be their nature, space and time must be so constituted as to make the speed of light absolutely the same in all directions, and absolutely independent of the motion of the person who measures it.*
>
> THE PRINCIPLE OF RELATIVITY: *Whatever might be their nature, the laws of physics must treat all states of motion on an equal footing.*
>
> KIP THORNE : 1994 [144]

The path taken by 20th and 21st century gravitational physicists is the trampled and arguably barren ground where the starving herd has come to coddle a theory that "involves unavoidable singularities," a theory that "moreover, carries within itself the seeds of its own destruction."

Ironically, even before Einstein invented his gravity-excluding *Special* Theory of Relativity, in an 1898 *Nature* article, Sir Arthur Schuster proposed a pattern of motion and a physical process having the potential to explain gravity and inertia. Schuster's ideas strongly echo the Rotonians' Space Generation Model. He was even explicit in seeking empirical proof ("How are we to prove . . . ?") one way or the other. The answer proposed herein (125 years later) is of course to fulfill Galileo's proposal from 1632, i.e., to build and operate humanity's first Small Low-Energy Non-Collider.

A non-oscillation result would strongly indicate (if not prove) that "matter ***is*** [indeed] an endless stream constantly renewing itself and pushing forward the boundaries of our universe." In the 20th century's first decades the table was thus set for Einstein (or anyone else) to build on this idea with the Equivalence Principle ("the floor comes up"). Just pursue the possibility that accelerometers are not schizoid liars; they actually tell the truth about their states of motion. *But no.* Einstein totally dropped the ball, taking instead the opposite approach. Among other places, Einstein's position is emphatically stated in a passage quoted by the physicist and biographer Abraham Pais:

> I was, for general reasons, firmly convinced that there does not exist absolute motion . . . It is my conviction that pure mathematical construction enables us to discover the concepts and the laws connecting them, which give us the key to the understanding of the phenomena of Nature. [145]

Though most biographers fawn over Einstein's genius, in this instance Pais at least tacitly recognizes how the man's intellect was infused with a large dose of hubris:

> It seems to me that here Einstein grossly overestimates the capabilities of the human mind, even of one as great as his own.

The damage to physics caused by the relativistic perspective is not just its embrace of singularities, but has more fundamental and far-reaching effects. This assessment is discussed in greater detail in **Part 2**, a few of whose main points will be recounted below.

First, let us consider another statement or two by Einstein, reflecting his affection and unwavering commitment to his favorite theory:

> The theory of relativity is a fine example of the fundamental character of the modern development of theoretical science. The initial hypotheses become steadily more abstract and remote from

> experience ... The theoretical scientist is compelled in an increasing degree to be guided by purely mathematical, formal considerations in his search for a theory, because the physical experience of the experimenter cannot lead him up to the regions of highest abstraction.
>
> The problem of gravitation was thus reduced to a mathematical problem. [146]

Cringeworthy stuff. With all his weighty influence, Einstein thus gave the green light to mathematically-minded theoreticians who were (by Einstein) "granted the right to give free reign to [their] fancy, for there is no other way to the goal." Wince. Cringe. Wince.

One of Einstein's key motivations was the search for *simplicity* in physical principles and their mathematical expression. The mathematics of a perfectly symmetrical, motionless world is simpler than the mathematics of a world full of galaxies, stars, background debris, and ethers. Thus a common prop invoked to justify various Einsteinian principles (e.g., the constant speed of light) is a windowless box. Even better would be a perfectly insulated, non-rotating windowless box, far from any astronomical bodies. Therein the laws of light propagation might appear isotropic and symmetrical — "***at least locally***," as they say. But in the real, exposed, anisotropic, rotation-ubiquitous, asymmetrical world, Einstein's principles do not fare so well.

One of the most illustrative examples is a large axially-symmetric, rapidly rotating body, a body like Roton (or even Planet Earth). For certain purposes, a body rotating near the speed of light robustly clarifies the argument. High-profile popularizers of physics like Brian Greene, Sean Carroll, and Matthew Strassler have claimed that the speed of light is always equal to the constant c "no matter what." Kip Thorne is another one of the many who have made the same claim using similar language.

This is a flat out ***LIE***. The lie is told, presumably, to appease the ghost of Einstein. Earth's Global Positioning System would yield unacceptably large position errors if it did not account for the ***FACT*** that, with respect to observers on Earth's surface, eastwardly emitted light signals travel at speeds less than c. And westwardly emitted light signals travel at speeds greater than c.

An even more dramatic and conclusive example — devised as a thought experiment — is found in **Part 2**, §7.1, where rotation is not needed to establish the point. The Section begins with absurd statements from physicist Ethan Siegel, who proves that, under Einstein's influence, some modern physicists can no longer tell the difference between up and down. Referring to a photo of a NASA Shuttle launch, Siegel spews nonsense and contradicts himself several times over. After exposing Siegel's foolishness, we segue into the scenario alluded to above: A thought experiment involving only *uniform* motion — not in an artificially sterile and featureless backdrop, but in the real world.

Specifically, we imagine three space ships traveling in the same line, with the middle ship spaced an equal distance from the other two, several dozen Astronomical Units apart. This inter-distance separation is measured by non-traveling observers who experience the Universe as an essentially isotropic, homogeneous distribution of light sources. The speed of the ships, measured by the same observers, is $v \approx 0.99\,c$, which means that the occupants will experience an extreme instance of *relativistic aberration* — also known as the *Headlight Effect*. [147, 148] (See Figure 63.) The leading ends of the ships are hot. The trailing ends are cold. Light sources in the direction of travel are blueshifted and bunched up toward their direction of travel. Light sources opposite the direction of travel are redshifted and visibly spread out. To the space travelers, the Universe appears quite *an*isotropic.

A physicist named Dr. Carroll is an occupant of the middle ship. One of his two sons is aboard the lead ship. The other son is aboard the trailing ship. Sadly, the Carroll brothers both suffer from a terminal disease that is likely to kill them in the very near future, most likely within hours. A medical doctor aboard the middle ship with Dr. Carroll discovers a cure, a cure that could be

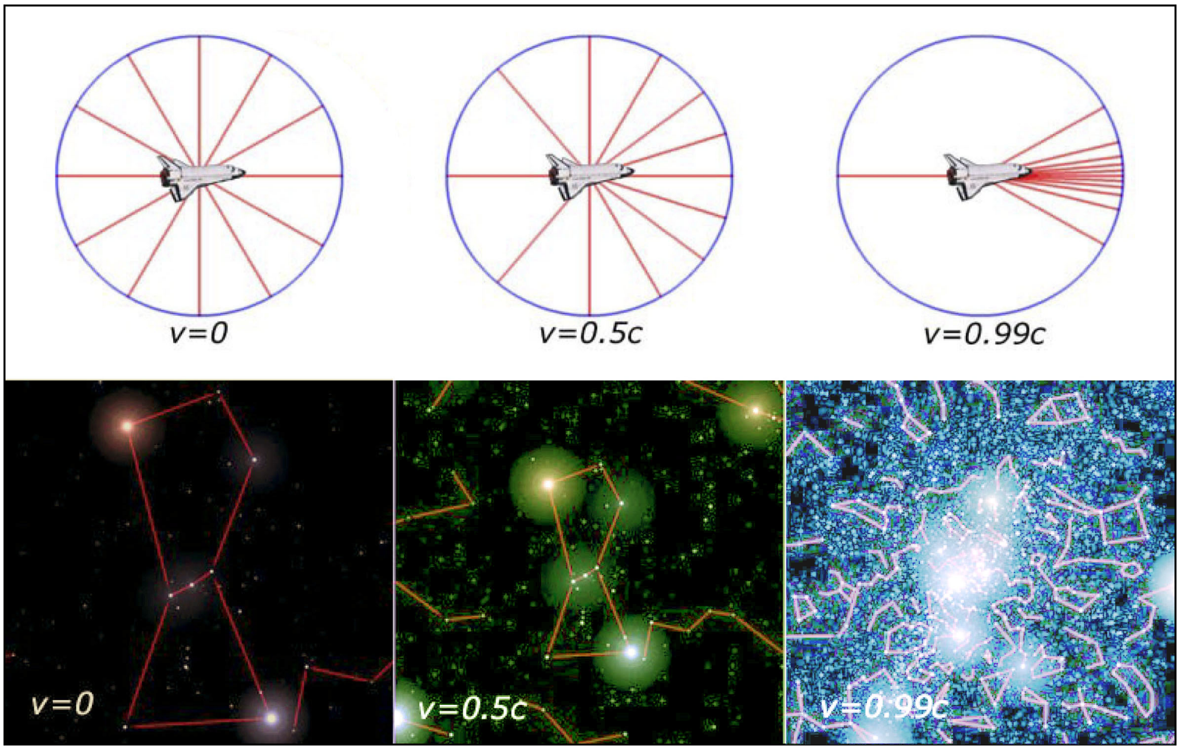


Fig. 63. **Headlight Effect.** According to Einstein, for any two inertial systems, "all directions are optically equivalent." [149] This means that occupants of the Shuttle are entitled to think of themselves as being ***at rest***, as the other inertial system, i.e., the whole Universe, whips past them. According to Einstein, if three Shuttles are traveling in a line (as described in the text) it will take *exactly the same time* for a light signal to travel from the middle ship to either the leading or trailing ship. Since the life of one of Dr. Carroll's sons depends on the truth or falsity of this edict, he snaps out of the bullshit, and admits that a backward-sent signal would actually take much less time to reach the rear ship (i.e., travels *much faster than c*) than the time it would take a foreward-sent signal to reach the lead ship (*much slower than c*). As a matter of physical *fact*, **the speed of light almost *NEVER* $= c$.** (Figure image adapted from A. Patruno. [148])

administered shortly after the message with the prescription arrives. The cruel kicker is that Dr. Carroll is allowed to send a message in only one direction. If the ships were motionless against an isotropic distribution of stars and galaxies, a radio signal would take a couple hours to travel from one ship to its neighbor in either direction.

Over the course of his career, Dr. Carroll has publicized, has taught his students, and has sworn up and down (in subservience to *Big Al*) that the speed of light $= c$, "no matter what." If true, then, faced with the present dilemma, he might as well flip a coin to decide which son is saved and which one will probably die. According to scripture, the signals should take the same time to reach either the leading or trailing ship. This might be the guess if all three ships were enclosed in a humongous box, a humongous perfectly insulated windowless box. Pretty stupid, right.

In this life-or-death situation, we may surmise that Dr. Carroll will snap out of his dogmatic stupor and admit: Evidence gathered by looking out the window indicates that a signal sent backward to the trailing ship would take much less time to reach his rearward son (minutes) than would a signal sent ahead to his foreward son (days). In a flash Carroll decides that sending the signal backward is how to maximize the chance that at least one of his sons will survive. The "light speed always = c no matter what" foolishness may have been good theater (or not). But in the real world the one-way speed of light really does vary and it really does depend on direction. As is clearly the case for Earth's GPS and many other more extreme cases that can be easily imagined.

The mathematics of anisotropic light propagation is more complicated than Einstein would like. Too bad! Admittedly, for many cases the assumption of isotropic propagation saves labor, perhaps looks prettier, and gets the job done. Given the above life-or-death situation (or even out of simple scientific *honesty*) ought we not to ask: Why not come clean and admit that the light-speed isotropicity, "optically equivalent" schtick is just a game? It's an exercise in scientific religion (faith), if you will. An exercise that could in some cases cost lives if taken too seriously.

20˙2. *Concepts of Light and Mass*

Another extreme case that exposes the folly of relativistic thinking involves a rapidly rotating wheel. Its rim is very heavy, even when not rotating. The weight of its hub and spokes we regard as negligible. Suppose we have two such wheels (A) and (B). When at rest they are identical in every way. They are located in the far reaches of intergalactic space. We can weigh the wheels by accelerating each one with a rocket mounted at their respective hubs, perpendicular to the rotation plane. The wheels are separated far enough apart that their influence on each other is negligible. One of the wheels (A) has been made to rotate by an array of rockets temporarily attached to the circumference, oriented tangential to the rim. After these rockets bring the wheel up to speed and expend their fuel, they fly off on tangents, so that (A) is again identical to the non-rotating wheel (B)—except for the rotation (and any internal effects the rotation may cause).

One of the many consequences of relativity theory that Rotonians agree with is that (A) will now be *heavier* than (B) by the amount:

$$m_{\text{A}} \simeq \frac{m_{\text{B}}}{\sqrt{1 - r^2\omega^2/c^2}}\,, \tag{13}$$

where r is the radial distance to the rim and m_{B} is the weight of a non-rotating wheel. The equation is approximate because exactitude depends on the slightly different speeds of the inner and outer radii of the rim. (And we neglect the weight of the hub and spokes.) Eq 13 would be exactly true for some median distance between these limiting radii. For rotation speeds approaching c the mass difference would become appreciable and measurable by our rocket-weighing system.

The significance of this mutually agreed-about weight difference is discussed in **Part 2**, §8 and §9. The example bears not only on the conflicting interpretations of the effect but on the implications it raises with regard to the difference between active gravitational mass m_{A} and passive gravitational mass m_{P}. It is generally agreed (even by Rotonians) that the latter mass is identical to inertial mass: $m_{\text{I}} \equiv m_{\text{P}}$. Whether or not *active* gravitational mass should be included in the identity has been a subject of some controversy and discussion over the decades. The standard assumption is that $m_{\text{A}} \equiv m_{\text{P}} \equiv m_{\text{I}}$. But the Rotonians disagree.

Relating the question back to the rotating wheel, the standard assumption is consistent with the assessment by Edwin F. Taylor and John A. Wheeler, who assert that:

> "Relativistic mass . . . " makes increase of energy of a particle with velocity or momentum appear to be connected with some change in internal structure of the particle. In reality increase of energy with velocity originates in geometric properties of spacetime itself. [150]

Vague fluff-talk like "originates in the geometric properties of spacetime itself" is about what we'd expect from John Wheeler the plunger. "In reality," given that one of our two wheels is *heavier* than the other only because it rotates, it becomes intuitively obvious that this difference *must be* attributable to a "change in internal structure." There must be a way to ***picture*** the change that makes one wheel heavier than the other — especially as the number of atoms in them is exactly the same.

Of enormous significance in the electrodynamics of moving bodies is that the *absolute* ***increase*** in the mass of our spinning wheel corresponds to the *absolute* ***decrease*** in the rates of clocks on the rim, in inverse proportion:

$$f_A = f_B\sqrt{1 - \frac{r^2\omega^2}{c^2}}\,. \tag{14}$$

How can it be that, as the rates of clocks decrease, the corresponding masses increase? Both effects can be pictured as the oscillatory behavior of electromagnetic waves that get bunched up in one direction of motion and spread out in the opposite direction. Adding the number of bunched up wave crests to the number of spread out wave crests yields a sum that averages out to an excess given by the same ratio (as in Eq 13):

$$N_{\lambda A} = \frac{N_{\lambda B}}{\sqrt{1 - r^2\omega^2/c^2}}\,. \tag{15}$$

Rotonians propose that *matter waves* are subject to the same kind of "change in internal structure" corresponding to the increased mass of the spinning wheel. Therein lies the structural difference that arguably explains the mass difference.

As explained in **Part 2**, this intuitive explanation for "relativistic" mass increase and time dilation leads to a novel scheme for understanding active and passive gravitational mass. The relationship between these conceptually distinct kinds of masses in GR and Newtonian gravity is one of the unresolved issues that motivated physics historian Max Jammer to echo the assessment that, in contemporary physics the concept of mass remains "shrouded in mystery." More bluntly, that "mass is a mess." Rotonians surmise that mass is a mess, ultimately, because ***motion is also a mess***, because Earthians refuse to believe their accelerometers.

The Rotonian conception of gravity is not as a static, frozen warpage. It is a ***process*** *that unfolds in time.* It follows that, if clocks slow down, then so does the rate of space generation; i.e., the *active* gravitational mass of the body in question is correspondingly reduced. Whereas the same body's inertial (passive gravitational) mass will increase inversely, as per the analogy with the rotating wheel (net bunching of wave crests). In the interest of cleaning up the mess, the SGM thus proposes — as discussed with various illustrations in **Part 2** — that active gravitational mass and inertial mass are not generally equal. Rather, as inertial mass increases by the factor: $1/\sqrt{1 - v^2/c^2}$, (or $\sqrt{1 + 2GM/rc^2}$) active gravitational mass decreases by the inverse: $\sqrt{1 - v^2/c^2}$, (or $1/\sqrt{1 + 2GM/rc^2}$). The difference between the arguments in these expressions, v^2/c^2 and $2GM/rc^2$ corresponds to the difference between motion *through* space vs. motion *OF* space.

This proposal implies profound consequences for understanding the phenomena of Dark Compact Astrophysical Objects — whether of the stellar, galactic (supermassive) or intermediate variety. When combined with other physical facts borne of quantum thory and observational astrophysics, the proposal also implies profound cosequences for cosmology, a few of which we turn to next.

20˙3. *Fundamental Constants, Newton's G, and Cosmology*

Another reason that Jammer echoed the assessment "mass is a mess" is the bewildering morass of research done with respect to its atomic manifestations, prior to and including quantum theory. One of the problems pertains to the *stability* of an electron (and also whole atoms). In the case of the electron, the problem is that it is a system characterized by one unit of negative "charge." Since like charges repel, the perennial question is: Why don't electrons blow themselves apart? B. K. Ridley put it like this:

> The rest mass energy is just the electrostatic energy arising out of one bit of the charge repelling all the other bits. The electron would like to explode, but something holds it together and there it sits, full of pent-up energy . . . What holds the repelling bits of negative charge together? [151]

The problem was posed before the advent of quantum theory and has persisted afterward, even as an effective stop-gap measure has been put in place. The stop-gap measure is called *renormalization*. One of its inventors was Richard Feynman, who expressed his dissatisfaction by writing of renormalization as a "shell game . . . I would call [it] a dippy process . . . hocus-pocus . . . I suspect that renormalization is not mathematically legitimate." [152] Dirac was also very critical. And although, decades later, most physicists have stopped grumbling, the prediction of Max Born may yet turn out to be relevant:

> Today all these efforts appear rather wasted; quantum theory has shifted the point of view, and at present the tendency is to circumvent the problem of self-energy rather than to solve it. But one day it will return to the center of the scene. [153]

Renormalization has sometimes been characterized as "taming" the otherwise troublesome infinite self-energies of electrons. They've been effectively swept under the carpet, to facilitate analysis and making sensible well-behaved predictions. The many high-profile complaints about the validity of renormalization faded toward the end of the century as physicists got used to the fact that, however mathematically dubious, the scheme worked.

Another aspect of the problem that pertains more directly to another famous feature of quantum theory concerns the time–energy uncertainty relation ($\Delta E \cdot \Delta t \geq h$) and the question of energy conservation. In one of his last published papers, Erwin Schrödinger reflected on the problem:

> The said uncertainty relation is usually taken to mean that in principle an infinite time is required for finding out the exact value of the energy. It is difficult to see how "after" doing so we should still manage to ascertain that the value we have found does not change with time.
>
> The detailed validity of the conservation law. . . is the point under discussion that I do not take for granted. [154]

So far we have that electrons want to blow themselves up and that energy may well be perpetually increasing in such a way as to camouflage the fact.

We next combine these understandings and mysteries about micro-physics with the explorations by Dirac and others pertaining to certain numerical relationships between the microcosm and the Universe as a whole. Among the various head-scratching relationships is the following. Comparing the electrostatic force and the gravitational force between a proton and an electron (as in a hydrogen atom) we get a ratio of about 10^{40}. Comparing the "scale" of the Universe (often characterized as the "Hubble radius") to the scale length of an atom (often characterized as the Bohr radius) yields a ratio of similar magnitude. More or less in the footsteps of Dirac, who tried building a model involving these relationships called the "Large Numbers Hypothesis," in 1952 Herman Bondi wrote:

> There are, however, a few numerical 'coincidences' arrived at by combining cosmical, 'ordinary size' and atomic measurements. These coincidences are very striking and few would deny their possible deep significance, but the precise nature of the connexion they indicate is not understood and is very mysterious.
>
> The likelihood of coincidences between numbers of the order of 10^{39} arising for no reason is so small that it is difficult to resist the conclusion that they represent the expression of a deep relation between the cosmos and microphysics, a relation the nature of which is not understood.
>
> In any case it is clear that the atomic structure of matter is a most important and significant characteristic of the physical world which any comprehensive theory of cosmology must ultimately explain. [155]

Dirac himself may have been inspired by the cosmic speculations that pre-date his own, by John Q. Stewart in 1931. Stewart was evidently motivated by Hubble's suggestion that the redshift of distant galaxies is ***not*** due to Big Bangist receding galaxies:

> On the hypothesis, however, that the nebular red shift is not indicative of a true velocity of recession . . . one might look for a connection between [the cosmic scale factor] and other universal constants. [156]

Stewart proposed that the sought connection would involve ratios such as that between the electron mass to the proton mass, between the electrostatic force and the gravitational force in an atom, and the fine structure constant, α. He took a stab at an expression that relates these ratios to one another and remarked:

> Considering the large numbers involved, the [proposed expression] is simpler than would be expected if it is assumed to represent a relationship due merely to chance.

The final component of our synthesis is deSitter's cosmological model, according to which the redshift is indeed not a result of receding galaxies. Instead, it is due to the rates of clocks being slower in the distant past. Astronomy historian R. W. Smith explains:

> The wavelength of light should increase — that is, shift toward the red — with increasing distance from the origin of the coordinates. The effect that deSitter predicted was not due to a real recession of distant stars or nebulae. Instead the intrinsic properties of space and time in [deSitter's solution] cause clocks to appear to run more slowly the further they are from the observer, and so the atomic vibrations within a far-off galaxy appear to slow down, the frequency of light decreases, the wavelength of light thereby increases and a redshift is observed. [157]

Robertson and Noonan referred to the deSitter model as "the only non-static stationary model, [because although] the fundamental world-lines expand away from each other . . . they also present the same appearance at any cosmic time." [158] This feature of expanding (exponentially) yet always looking the same corresponded also to the "Steady State" models of Hoyle, Bondi and Gold. For this reason they adopted the deSitter metric for their theories. But they maintained the assumption that gravity is a force of attraction and refused to believe accelerometers. So to keep the density constant, they invoked "spontaneous generation of matter" of *new particles of matter* that just magically popped into existence. Whereas the SGM cosmology posits the "spontaneous generation of matter" as being *out of every body of matter that already exists.* The process whereby this happens is gravity.

As conveyed in **Part 2**, the above facts come together to yield a model that predicts a matter density parameter: $\Omega_{\rm M} = 2/9 = 0.222\ldots$ and a Hubble parameter $h \approx 63.4$. Most notable is the role played by the fine structure constant α, and the definition of Newton's constant in terms of a few other constants that play a large role in the rest of physics:

$$G = 8\left(\frac{\rho_\mu}{\rho_{\rm N}}\cdot\frac{{\rm a}_\circ c^2}{m_{\rm e}}\right) = \frac{4}{\pi\alpha}\left(\frac{\rho_\mu}{\rho_{\rm N}}\cdot\frac{hc}{m_{\rm e}^2}\right) = \frac{\alpha^3}{2}\left(\frac{{\rm a}_\circ}{R_{\rm C}}\cdot\frac{c^2{\rm a}_\circ}{m_{\rm p}}\right), \tag{16}$$

where ρ_μ is the mass-equivalent of the background energy-density of the Universe, $\rho_{\rm N}$ is the nuclear saturation density, ${\rm a}_\circ$ is the Bohr radius, $m_{\rm e}$ is the electron mass, h is the Planck constant, $R_{\rm C}$ is the SGM cosmic scale factor (three times larger than the Hubble radius), and $m_{\rm p}$ is the proton mass.

Some of these features can be deduced from studying the Cosmic Everything Chart (**Part 2**, Figure 12), which may be thought of as a treasure map. Plotted there are the masses of representative material bodies spanning the range from fundamental particles to galaxy clusters, with respect to density. Among the most cogent features of the Chart is the continuous data trajectory across the Chandrasekhar Limit Mass line and the Schwarzschild (edge of the world) horizon line.

The *construction* of this model, as presented in Sections §10–§12 in **Part 2** is accompanied in adjacent Sections, by the veritable *destruction* of the standard Big Bang model (especially Sections §13 and §14)—with all of its grotesque appendages and dubious fudge factors. As depicted in our Kid From Roton Figure (copied below), standard cosmology is destined to collapse because of the dry rot foundation.

20˙4. *Final Thoughts*

Part 2 began with an amplified chorus of grumbles about standard physics and cosmology from *within* the academy (Phipps, Smolin, Lopez-Corredoira, Disney). Having cited numerous critical echoes and additional grumbles along the way, and having built up the alternative model sketched above (on the basis that accelerometers always tell the truth) Rotonians are naturally suspicious of any claims about G-Waves being produced by black hole binary collisions or any other alleged source.

Our history of the subject omits many subsidiary subjects that are prominent features in Kennefick's book. For example, the pre-relativistic discussions about the speed of gravity (Laplace and others), the so-called "Problem of Motion," the vast industry of numerical simulations and template construction, Einstein's changing mind on the subject, and various other behind-the-scenes developments and discussions. Our main concern in **Part 3** has been to make it abundantly—perhaps *over*abundantly—clear that the enterprise is plagued by many simple, obvious, and fatal inconsistencies and contradictions. Neither the principle researchers nor their underlings ever produce a spacetime diagram showing the propagation of laser beams in LIGO's arms as a G-Wave is passing perpendicularly through the plane of the apparatus. If this diagram were to be drawn, it would arguably look very much, if not exactly like our Figure 3 and the Top of Figure 4. A physically

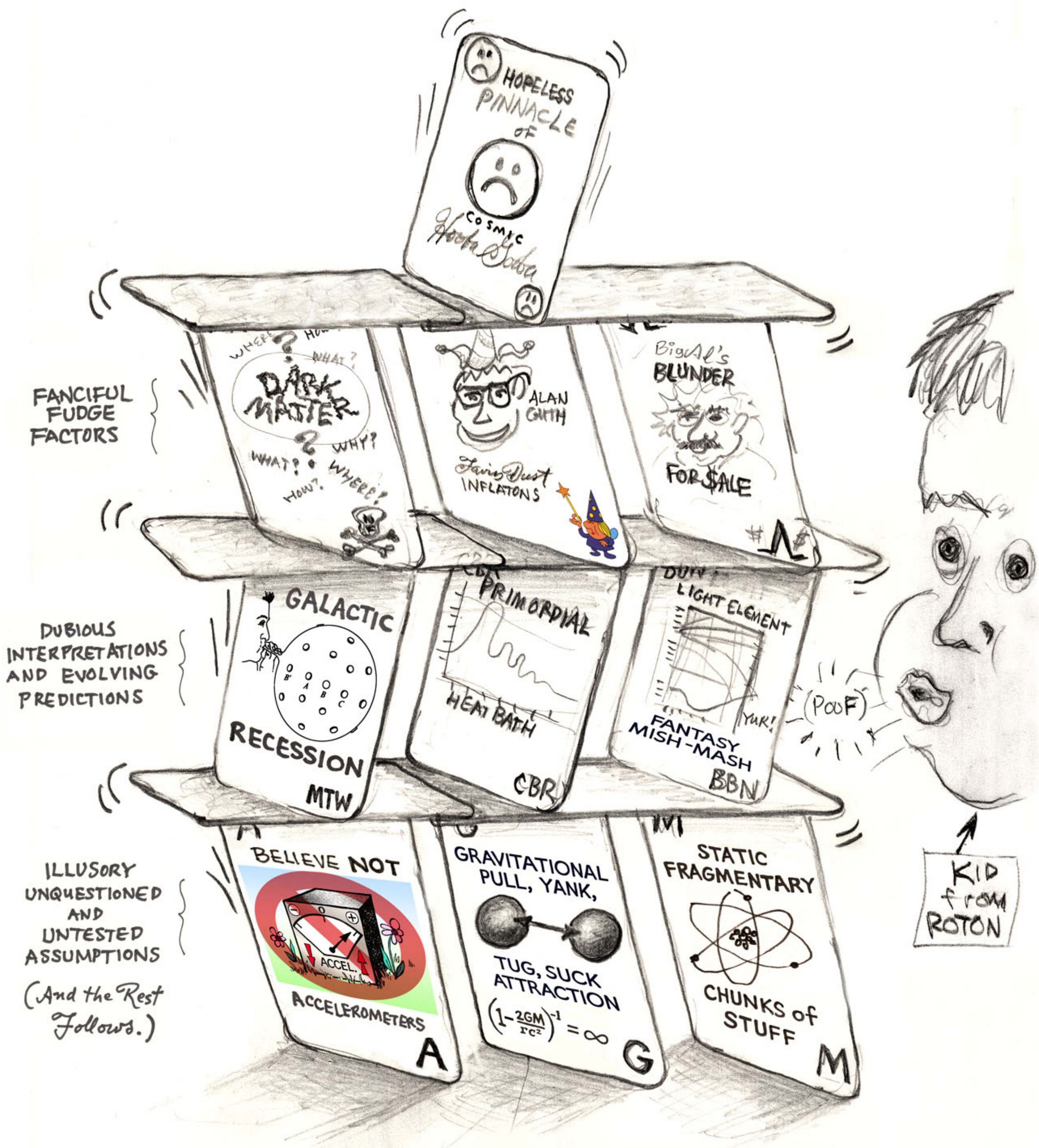


Fig. 64. **Kid from Roton Meets the Wet-Noodle "Foundations" of Modern Cosmology:** Poof! Would-be Earthian cosmologists hope to paint an accurate picture of the Universe while still accepting the bottom three foundational cards (assumptions) as true. It is a futile effort, destined to result in a grotesque monstrosity. Like building a "house" with rubber nails and wet pudding. Neither standard theorists, nor the "alternative" cosmologists mentioned in the text can conceive a sensible Universe because none of them understands the *first thing about gravity*, because they all think accelerometers are schizoid liars. The first thing to understand about gravity and the Universe — what is understood by every kid from Roton — is that *accelerometers always tell the truth.* Everything is getting bigger and bigger, faster and faster, all the time. [159]

sensible diagram makes it obvious that LIGO is incapable of detecting or measuring G-Waves. This conclusion is reached independent of the Rotonians' Space Generation Model. However convincing their façade may appear, the LIGO enterprise must therefore be a hoax.

The Rotonian perspective — with its new model of gravitation and cosmology — is not needed to see the dubiousness of the G-Wave industry. The value of mixing it into the discussion is that it fulfills the need for a plausible, testable alternative, i.e., the antidote to the plague of relativistic thinking. Cogent as our conceptual, graphic, and mathematical arguments may be, what is inestimably more important — the way to unequivocally prove whether the Rotonian perspective rings true or not — is to fulfull the proposal made by Galileo in 1632. We need to at last build and operate humanity's first Small Low-Energy Non-Collider.

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